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*Pre-Final*

# River Mile 10.9 Removal Action Pre-Final Design Report, Lower Passaic River Study Area

Prepared for

Cooperating Parties Group, Newark, New Jersey

November 30, 2012

**CH2MHILL®**

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# Acronyms and Abbreviations

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ADCP	acoustic Doppler current profiler
AOC	Administrative Settlement Agreement and Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
AUD	Acceptable Use Determination
bgs	below ground surface
BMP	best management practice
BODR	Basis of Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	<i>Code of Federal Regulations</i>
cfs	cubic feet per second
CZMA	Federal Coastal Zone Management Act
COPC	chemical of potential concern
CPG	Cooperating Parties Group
CWA	Clean Water Act
EFH	essential fish habitat
ft	foot, feet
ft <sup>3</sup>	cubic feet
HMW	high molecular weight
hr	hour
IDW	investigation-derived waste
in.	inch, inches
LAeq	equivalent continuous A-weighted sound pressure level
lb	pound
LDR	Land Disposal Restrictions
LMW	low molecular weight
LPR	Lower Passaic River
LPRSA	Lower Passaic River Study Area
m	meter
m <sup>2</sup>	square meter
NCP	National Contingency Plan
ng	nanogram
NGVD	National Geodetic Vertical Datum
NJAC	New Jersey Annotated Code
NJDEP	New Jersey Department of Environmental Protection
NJSA	New Jersey Statutes Annotated
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
OSR	Off-Site Rule
Pa	pascal
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans

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PPE	personal protective equipment
ppm	parts per million
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RDWP	removal design work plan
RM	river mile
SOP	standard operating procedure
SVOC	semivolatile organic compounds
TBC	to be considered
TCDD	tetrachlorodibenzo-p-dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time-Critical Removal Action
TEQ	toxicity equivalency quotient
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
UTS	Universal Treatment Standards
VOC	volatile organic compound
WQC	Water Quality Certification
yd <sup>3</sup>	cubic yard

# Introduction

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This Pre-Final Design Report (Pre-Final) for River Mile (RM) 10.9 of the Lower Passaic River (LPR) has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action, Docket No. 02-2012-2015 (USEPA, 2012a), by the Cooperating Parties Group (CPG) (hereinafter referred to as the RM 10.9 AOC). The AOC became effective on June 18, 2012.

The sediment removal will be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as a Time-Critical Removal Action (TCRA). This Pre-Final describes the removal action selected by the USEPA in the Action Memorandum/ Enforcement dated June 18, 2012 (USEPA, 2012b).

This Pre-Final is based on the AOC (USEPA, 2012a), the Action Memorandum/Enforcement (USEPA, 2012b), the Removal Design Work Plan (RDWP) (CH2M HILL, 2012a), and the Basis of Design Report (BODR) (CH2M HILL, 2012b). The purpose of this Pre-Final Design Report is to describe the overall design for RM 10.9, including the various engineering design packages. In addition to the design packages attached to this Pre-Final are the following supporting appendices:

- A RM 10.9 Concentration Data and Figures for 2,3,7,8-TCDD, Mercury, and Total PCBs at Select Depth Intervals
- B Dredging and Material Transport Design Support Documents and Calculations
- C Dredging Design Engineered Plan Drawings
- D Technical Specifications
- E Construction Environmental Monitoring QAPP Addendum
- F Project Health and Safety Plan
- G Community Health and Safety Plan
- H RM 10.9 Removal Action Sediment-Washing Bench-Scale Testing Report
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- J Construction Quality Control Plan
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- L Project Schedule

## 1.1 Project Description

The RM 10.9 Study Area extends, bank to bank, between RM 10 and RM 12 of the Lower Passaic River Study Area (LPRSA) (**Figure 1-1**). The RM 10.9 Sediment Deposit Area, an area within the RM 10.9 Study Area, extends approximately 2,380 feet (ft), from RM 10.65 to RM 11.1. The RM 10.9 Removal Area (**Figure 1-2**) is an approximately 5.6-acre area located on the eastern side of the LPRSA within the RM 10.9 Sediment Deposit Area.<sup>1</sup>

The removal area is situated along an inside bend of the LPR upstream of the DeJessa Park Avenue Bridge and includes the mudflat and point bar in the eastern half of the river channel. It is bounded to the west by the navigation channel of the Passaic River and to the east by the Riverside Park complex, which is owned and operated by Bergen County and the Town of Lyndhurst.

The extent of potentially exposed surface sediment shown in **Figure 1-2** was generated from the -2 ft elevation contour (NGVD29), which represents the mean low water for this part of the LPR. The data source was the July 2011 bathymetry survey conducted as part of the RM 10.9 Characterization Program (CH2M HILL and AECOM, 2012). The line represents the extent to which the river bottom/sediment is exposed during low tide at mean low water. The Action Memorandum/Enforcement (USEPA, 2012b) requires the removal of the highest near-surface

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<sup>1</sup> The removal area is approximately 0.6 acres greater than that specified in the AOC due to the inclusion of a narrow area that extends approximately 700 ft to the northeast. This area was included after a further review of the delineation sampling conducted by the CPG at the direction of USEPA (RM 10.9 Quality Assurance Project Plan [QAPP] Addendum A, May 2012). As a result of the sampling, the CPG proposed including the additional 0.6 acres into the RM 10.9 Removal Area in its August 1, 2012, letter to USEPA.

and shallow subsurface concentrations of the entire deposit, and that the RM 10.9 Removal Area to include that area that is exposed at low tide. The eastern boundary of the removal area is approximately defined by the mean high water mark (elevation 2.4 ft NGVD29).

Because of elevated concentrations of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDDs/PCDFs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), mercury, and other chemicals of potential concern (COPCs) and the potential for receptors from the neighboring park to be exposed to them, the CPG is required to perform all actions necessary to remove, treat, and/or properly dispose of approximately 18,000 cubic yards (yd<sup>3</sup>) of sediment from the designated portion (i.e., the removal area) of the RM 10.9 Sediment Deposit Area. The project involves the following scope elements:

- Mechanically dredge the contaminated surface sediments (to a depth of 2 ft below existing grade) from the RM 10.9 Removal Area
- Transport the dredged materials via barge to a stabilization facility
- Treat the contaminated sediments by stabilization at an existing permitted facility
- Treat barge supernatant at an offsite facility prior to discharge
- Cap the newly exposed sediment surface
- Transport the stabilized sediments to an out-of-state disposal facility

## 1.2 Removal Action Objectives

The removal action objectives for RM 10.9 include the following:

- Reduce the potential for exposure to receptors from sediments present in the RM 10.9 Removal Area
- Prevent potentially significant migration of contamination from the RM 10.9 Removal Area
- Remove approximately 18,000 yd<sup>3</sup> of surface sediment (top 2 ft) and stabilize it at an existing permitted facility
- Evaluate the means and methods for sediment removal
- Determine potential impacts of dredging contaminated sediment on surface waters and the means to minimize, or otherwise address, these impacts
- Identify and minimize/address potential impacts to the environment and public health
- Evaluate effectiveness of sediment capping methods on reducing bioavailability and migration of COPCs, including amending caps with activated carbon to mitigate the potential for contaminants to migrate through the sand caps
- Begin implementation of the RM 10.9 Removal Action in May 2013

## 1.3 Engineering Design Packages

The RM 10.9 TCRA is divided into the four engineering design packages listed below and illustrated in **Figure 1-3**:

- Dredging and barge transport
- Stabilization
- Capping
- Overland transportation and offsite (out-of-state) disposal

The engineering design is being conducted in three phases: the BODR (30 percent; submitted August 2012), the Pre-Final Design Report (90 percent; this report), and the Final Design Report (100 percent). Each design phase undergoes an internal review as well as a review by the CPG prior to being submitted to the USEPA for its review

and acceptance.

### **1.3.1 Dredging and Barge Transportation**

The dredging design package is performance based and consists of designs for the following activities:

- Dredging
- Transporting the dredged material by barge to the stabilization facility's off-loading site outside the RM 10.9 Study Area
- Monitoring water quality

### **1.3.2 Stabilization**

The dredged material will be transported from the removal area to an existing permitted stabilization facility for treatment. The stabilization design package is performance based and includes activities from the time the dredged-material barge is secured at the stabilization facility until the stabilized dredged material is loaded into trucks or rail cars for overland transport to the final, out-of-state disposal facility. These activities will consist of the following:

- Pumping and temporarily storing excess water from barges (as required)
- Off-loading dredged material from the barges
- Preparing (screening, mixing) sediment for stabilization
- Treating the sediment with Portland cement to stabilize the sediment
- Temporarily storing the treated sediment at the stabilization facility
- Loading the treated material onto trucks or rail cars for transport to the final, out-of-state disposal facility

### **1.3.3 Capping**

The capping design package will be a detailed design for selecting material and sizing and placing the cap. The approach described in this document consists of the following:

- Chemical containment modeling
- Active layer treatability study
- Cap placement plan and typical cap sections (active layer, sand layer, geotextile barrier, and armor stone)
- Erosion control design
- Cap material delivery and staging
- Cap placement criteria
- Water quality monitoring

### **1.3.4 Overland Transportation and Final Disposal**

The transportation and disposal design package is performance based and includes activities from the time the stabilized material is loaded into trucks until it is received and unloaded at the designated out-of-state disposal facility.

This design package also includes offsite transportation, treatment, and disposition of excess water removed from the material barges.

## Applicable or Relevant and Appropriate Requirements

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Conditions at the LPRSA RM 10.9 Removal Area meet the criteria for a TCRA under CERCLA, as set forth in Section 300.415(b)(2) of the NCP, 40 CFR Part 300. The TCRA specifies removal of a predetermined depth of sediment (uppermost 2 ft) and in-place capping of the remaining sediment. The removal action objectives are to mitigate potential threats to the public health, welfare, and the environment posed by the presence of the elevated levels of contaminants in the surface sediments in the RM 10.9 Removal Area and to minimize the availability of the contaminants. The removal action will be implemented by removing sediments and transporting it via barge to an offsite commercial stabilization facility with ultimate disposal at an out-of-state subtitle C landfill.

In accordance with CERCLA section 121(e)(1), no federal, state, or local permits are required for the portion of any removal or response action conducted entirely onsite, where such removal action is selected and carried out in compliance with Section 121. However, pursuant to 40 CFR Section 300.415(j), the removal action will, to the extent practicable considering the exigencies of the situation, attain substantive compliance with Applicable or Relevant and Appropriate Requirements (ARARs) under federal environmental or state environmental or facility siting laws. The design aspects that address substantive requirements or the intent of the permitting regulations are described in this section. During the final design, a full Compliance Requirements document describing how the removal action will comply with both onsite ARARs and all offsite administrative and substantive requirements will be developed.

Definitions of the ARARs and the “to be considered” (TBC) criteria set forth in the NCP are identified below:

- Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.
- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not “applicable to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site,” address problems or situations sufficiently similar (relevant) to those encountered at a CERCLA site that their use is well suited (appropriate) to the particular site.
- TBC criteria are nonpromulgated, nonenforceable advisories, criteria, or guidance to be considered for a particular release that may be useful for developing a CERCLA response action or for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include those in the NJDEP (1997) dredging technical manual and related best management practices.

Another factor in determining which requirements must be addressed is whether the requirement is substantive or administrative. “Onsite” CERCLA response actions must comply with the substantive requirements but not with the administrative requirements of environmental laws and regulations as specified in the NCP, 40 Code of Federal Regulations (CFR) 300.5, “Definitions of ARARs,” and as discussed in 55 *Federal Register* (FR) 8756 (March 8, 1990). Substantive requirements are those pertaining directly to actions or conditions in the environment. Administrative requirements are mechanisms that facilitate the implementation of the substantive requirements of an environmental law or regulation. In general, administrative requirements prescribe methods and procedures (e.g., fees, permits, inspections, or periodic reports) by which substantive requirements are made effective for the purposes of a particular environmental or public health program.

ARARs are grouped into three types: chemical specific, location specific, and action specific, and are presented in

Tables 2-1, 2-2, and 2-3, respectively.

## 2.1 Chemical-Specific ARARs

Chemical-specific ARARs include laws and requirements that establish health- or risk-based numerical values or methodologies for environmental contaminant concentrations or discharge. **Table 2-1** presents the chemical-specific ARARs, which are summarized here.

Because the removal action objectives include reducing the bioavailability of the contaminants, the New Jersey surface water quality standards and discharge criteria are relevant and appropriate. The LPR at RM 10.9 is categorized as an FW2-NT (fresh water, non-trout)/SE2 (saline estuary) water body from Dundee Lake downstream to the confluence with Second River. The designated uses of FW2 water bodies per New Jersey Administrative Code (NJAC) 7:9B-1.12 include the following:

1. Maintenance, migration and propagation of the natural and established biota;
2. Primary contact recreation;
3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment ( a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses

In all SE2 waters the designated uses are:

1. Maintenance, migration, and propagation of the natural and established biota
2. Migration of diadromous fish
3. Maintenance of wildlife
4. Secondary contact recreation; and
5. Any other reasonable uses

The relevant water quality criteria for the contaminants of concern are referenced in **Table 2-4**. General technical policies and numerical limits have been established under NJAC 7:9B. One of these policies is using USEPA Method 1631 to test for mercury. The NJDEP has the authority to set nutrient limits and require best available technologies. Mixing zones are allowed; rules on mixing zone distances are set forth, as well as methods to determine in-stream concentrations within mixing zones.

Effluent limitations for site remediation activities are equal to the remediation effluent standards listed in NJAC 7:14A-12, Appendix B, for any pollutant or pollutant parameter that either results from any removal action or is present onsite at a concentration greater than the applicable surface water quality standards, unless it has been demonstrated to NJDEP's satisfaction that the pollutant, upon discharge, will not cause, have the reasonable potential to cause, or contribute to an excursion above any applicable surface water quality standards. The effluent limitations for contaminants in the RM 10.9 Removal Area are referenced in **Table 2-5**.

The TCRA will be performed in such as way as to meet the surface water quality standards and effluent limitations to the extent practicable at the end of a mixing zone defined as at designated upstream and downstream monitoring points.

Because there are no federal or state promulgated standards for contaminant levels in sediments, and because the TCRA specifies removal of a certain depth of sediment, there are no chemical-specific ARARs for the sediments.

## 2.2 Action-Specific ARARs

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances. They generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to managing hazardous substances or pollutants. These requirements are

triggered by the remedial activities selected to accomplish a removal action. The action-specific requirements do not solely determine the remedial alternative, but do indicate how or to what level treatment or cleanup will be achieved.

**Table 2-2** presents the action-specific ARARs for the RM 10.9 Removal Action. The most important ARARs and their substantive requirements are discussed below.

The principal action-specific ARARs for the TCRA at the RM 10.9 Removal Area include the federal Clean Water Act (CWA), Section, 401 Water Quality Certification (WQC); the Rivers and Harbors Act, Section 10; and the associated New Jersey Land Use and Water Resources implementing regulations.

The CWA Section 401 WQC is implemented by NJDEP through the Waterfront Development Act (New Jersey Statutes Annotated [NJSA] 12:5-3). The Waterfront Development Act is implemented through Coastal Zone Management regulations (NJAC 7:7E) and Coastal Permitting Rules (NJAC 7:7). See **Table 2-6** for substantive requirements of the Coastal Zone Management regulations. The design includes preventive measures to minimize resuspension of sediment and water quality monitoring during dredging so that the proposed activity will not violate water quality standards. Post-removal restoration activities will be addressed in the construction documents. Monitoring will be conducted to confirm the effectiveness of the cap.

The dredging or placement of fill or structures such as bulkheads within navigable waters of the United States and other activities that may adversely affect aquatic ecosystems are regulated by the Rivers and Harbors Act, Section 10. Similar activities in any waters of the United States are addressed by CWA Section 404, for which the U.S. Army Corps of Engineers has jurisdiction. USACE Nationwide Permit 38, Cleanup of Hazardous and Toxic Waste (March 2012), is considered to be the applicable general permit, and its substantive requirements will be followed. The applicable substantive requirements include the following:

- Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high-water mark or high-tide line, must be permanently stabilized at the earliest practicable date. To the extent practicable, work should be performed within waters of the United States during periods of low flow or no flow.
- No activity may substantially disrupt the necessary life-cycle movements of those species of aquatic life indigenous to the water body, including those species which normally migrate through the area.

Dredged material in New Jersey is exempt from being a solid waste when it is regulated under certain statutes, such as the New Jersey Water Pollution Control Act, Waterfront Development Law, Clean Water Act, and Federal Coastal Zone Management Act (CZMA). Contaminated environmental media (e.g., sediment) are not hazardous waste but can become subject to regulation under the Resource Conservation and Recovery Act (RCRA) if they “contain” hazardous waste. USEPA generally considers contaminated environmental media to contain hazardous waste (1) when they exhibit a characteristic of hazardous waste or (2) when they are contaminated with concentrations of hazardous constituents from listed hazardous waste that are above health-based levels.

Dredged material that is subject to the requirements of a permit that has been issued under 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. Offsite sediment-processing and disposal facilities must comply with all administrative and substantive aspects of the regulations, including their own permit requirements, and may impose constraints prior to accepting the sediment.

## 2.3 Location-Specific ARARs

Location-specific ARARs are requirements that relate to the geographic position of the site. State and federal laws and regulations that apply to the protection of wetlands, construction in floodplains, and protection of endangered species in streams or rivers are examples of location-specific ARARs.

**Table 2-3** presents the location-specific ARARs for the RM 10.9 Removal Action. The principal location-specific ARAR is CZMA, administered by National Oceanic and Atmospheric Administration (NOAA), and the associated

implementing NJDEP laws and regulations that apply to dredging and placement of a sediment cap. The New Jersey Waterfront Development Law (NJSA 12:5-3) is implemented through the CZMA and the Coastal Permitting Program Rules; substantive requirements have been described in Section 2.2.

TABLE 2-1  
**Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements**  
*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Act/Authority	Citation	Brief Description	Applicability and Anticipated Requirements
New Jersey Water Pollution Control Act, New Jersey Water Quality Planning Act			
Surface Water Quality Standards	N.J.A.C. 7:9B Surface Water Quality Standards	Establishes standards for the protection and enhancement of surface water resources.	Relevant and appropriate—used by the state in setting NJDPES discharge limits and Waterfront Development Law requirements. The RM 10.9 Removal Area is classified as FW2-NT/SE2, which has corresponding surface water quality standards for constituents such as turbidity, dissolved oxygen, and various toxic substances. The anticipated requirement is to use best management practices during dredging and to comply with these standards at designated upstream and downstream monitoring locations. Also, the removal action objective of the post-dredge cap is to isolate the remaining sediment contaminants from the environment, including their discharge into the surface water.
New Jersey Pollutant Discharge Elimination System (NJPDES)	Surface Water Discharge Criteria	N.J.A.C. 7:14A	Establishes discharge standards to protect water quality.
			Relevant and Appropriate—refer to Waterfront Development Law.

TABLE 2-2

**Action-Specific Applicable or Relevant and Appropriate Requirements***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Act/Authority	Citation	Brief Description	Applicability and Anticipated Requirements
Clean Water Act 33 U.S.C. 1251			
Section 401 Water Quality Certification		Under Section 10 of the Rivers and Harbors Act and Section 404 of the CWA, federally authorized projects are required to obtain Water Quality Certification pursuant to Section 401 of the CWA. A Water Quality Certification (WQC) would specify the requirements to be implemented so that the proposed activity will comply with water quality standards. Activities requiring a Water Quality Certification include those where a federal permit is required, for example:  Discharge of dredged material dewatering effluent Placement of fill in waters of the United States; Temporary discharges of decant waters from dredge material disposal sites or from barges and vessels.	Applicable. New Jersey has delegated authority. Section 401 of the CWA is implemented through compliance with the New Jersey Waterfront Development Law (NJSA 12:5-3; NJAC 7:7 and 7:7E), Coastal Zone Management Rules (NJAC 7:7E-1 et seq.), and Coastal Permit Program Rules (NJAC 7:7). Refer to those sections below for anticipated substantive requirements, which are proposed to include implementation of best management practices and monitoring to meet water quality criteria during barge and dredge movement, anchoring, and operations.
Section 404 Dredge and Fill Requirements		Regulates activities in waters of the U.S. including discharge of dredged materials, placement of fill materials, and reconstruction of mudflats.	Applicable. Substantive portions are proposed to include implementation of best management practices and monitoring to meet water quality criteria during barge and dredge movement, anchoring, and operations. USACE considers Magnuson-Stevens Fishery Conservation and Management Act as well as Section 401 Water Quality Certification requirements. Refer also to Section 10 of the Rivers and Harbors Act.
Pollution Prevention Regulations for Vessels	33 CFR Subchapter O	All vessels are required to have spill plans and emergency spill equipment	All fueling of boats will be at established marinas. Any fuel transfer over water necessary to run equipment on the barge will comply with Coast Guard regulatory requirements.
Section 10 Rivers and Harbors Act of 1899/ Section 404 Clean Water Act			

	33 CFR 320-330	Administered by USACE. Regulates activities such as dredging, and other construction in navigable waters of the U.S.	<p>Applicable. Substantive requirements are found in the General Permit and Regional Conditions. Nationwide Permit (NWP) #38 Cleanup of Hazardous and Toxic Waste March 2012 is anticipated to be the applicable General Permit and its substantive requirements will be followed. There are no substantive Regional General Conditions associated with NWP #38; however, a Pre-Construction Notification is required as part of NWP #38 and Regional General Condition #1; therefore, consultation will occur, although a permit is not required.</p> <p>NWP 38 substantive requirements include:</p> <p>Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Work should be performed within waters of the United States during periods of low-flow or no-flow.</p> <p>No activity may substantially disrupt the necessary life-cycle movements of those species of aquatic life indigenous to the water body, including those species which normally migrate through the area.</p>
Toxic Substances Control Act (TSCA)			
	40 CFR Part 761 Subpart D Storage and Disposal	Regulates PCBs and other toxic substances from manufacture to disposal.	<p>Applicable. Environmental media containing PCBs may be considered bulk PCB remediation waste. TSCA provides provisions for management of bulk PCB remediation waste at concentrations &lt;50 ppm; certain substantive requirements may be applicable, or approvals from the TSCA regional coordinator may be appropriate. NJDEP has endorsed the Action Memo for the RM 10.9 Removal Action. No additional substantive requirements are proposed.</p>
Federal Resource Conservation and Recovery Act			
Non Hazardous Solid Waste Program (Subtitle D)	40 CFR 239-258	Establishes requirements for generators, transporters, and facilities that manage non hazardous solid waste.	<p>Relevant and appropriate. NJ has delegated authority; refer to the N.J.A.C. 7:26 Solid Waste. Depending on contaminant concentrations, disposal of contaminated sediments may occur at an upland area and may need to be managed as a solid waste (e.g., treat to get rid of free liquids), prior to upland disposal. All administrative and substantive requirements of regulations will be followed for offsite activities.</p>

Hazardous Waste Management Program (Subtitle C)	40 CFR 262-265	Establishes requirements (e.g., EPA ID numbers and manifests) for generators, transporters, and facilities that manage hazardous waste.	Relevant and appropriate. Sediment that is dredged under a Water Quality Certification is exempt from being hazardous waste. NJ has delegated authority; refer to the N.J.A.C. 7:26G Hazardous Waste. However, contaminated sediments may fail hazardous waste characteristics (e.g., TCLP) and may be managed and disposed of at an offsite upland landfill. All administrative and substantive requirements of regulations will be followed for offsite activities. If contaminated sediments are hazardous and are disposed of at an upland location, they may need to be managed as a hazardous waste (e.g., treat to stabilize the contaminants and get rid of free liquids) prior to upland disposal.
Land Disposal Restrictions	40 CFR 268	Identifies hazardous wastes which are restricted from land disposal. All listed and characteristic hazardous waste or soil or debris contaminated by a RCRA hazardous waste and removed from a CERCLA site may not be land disposed until treated as required by LDRs.	Relevant and appropriate. Sediment that is dredged under a Water Quality Certification is exempt from being hazardous waste. However, contaminated sediments may fail hazardous waste characteristics (e.g., TCLP) and may be managed and disposed of at an upland landfill. All administrative and substantive requirements of regulations will be followed for offsite activities. If contaminated sediments are disposed of at an offsite upland location, they may need to be managed in a manner similar to a hazardous waste (e.g., treat to stabilize the contaminants and get rid of free liquids) prior to upland disposal.

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State of New Jersey Statutes and Rules—Waste Management and Site Remediation

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New Jersey Solid Waste Management Act	N.J.A.C. 7:26 Solid Waste & N.J.A.C. 7:26G Hazardous Waste	Establishes requirements for generators, transporters, and facilities that manage nonhazardous solid waste and hazardous waste	Substantive requirements for solid waste generators are applicable to onsite actions. All substantive and administrative requirements will be followed for offsite actions. Substantive requirements for hazardous waste generators may be relevant and appropriate.
	N.J.A.C. 7:26E Technical Requirements for Site Remediation	Establishes minimum regulatory requirements for investigation and remediation of contaminated sites in New Jersey, including surface water, sediment, and ecological evaluations.	Not an ARAR for this removal action, as no additional delineation testing of sediment is required. The NJDEP has endorsed the Action Memo; The design will state that bathymetric measurements to confirm the depth of sediment removed, and depth of cap will occur during implementation.
NJDEP Standards for Soil Erosion and Sediment Control Act	N.J.A.C. 2:90	The Hudson-Essex and Passaic Soil Conservation District governs all soil disturbances greater than 5,000 ft <sup>2</sup> .	Not applicable because the land disturbance at the upland construction support area somewhere in the region will be less than 5,000 ft <sup>2</sup> . Fill will be barged onto the site, and dredged sediment will be transported offsite via barge while wet.

NJDEP Technical Manual "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters", October 1997

Not promulgated, but enforceable technical manual prepared pursuant to N.J.S.A. 13:1D-111 to 1D-113.

To the extent practicable, the removal action will incorporate best management practices, sampling methodologies and analytical procedures. Practices will include use of an environmental clamshell bucket with sensors to ensure complete closure of the bucket before lifting the bucket; controlled descent and lifting; prohibiting barge overflow. To reduce the creation and dispersal of suspended sediments when finer-grained sediments are dredged, deliberate placement of dredged material in the barge to prevent spillage of material overboard; use of watertight barges or scows with solid hull or sealed hull construction; no rinsing or hosing of gunwales of the dredge scows during dredging except to the extent necessary to ensure the safety of workers maneuvering on the dredge scow.

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Federal Clean Air Act Section 112

National Emission Standards for Hazardous Air Pollutants

40 CFR 61

Provides emission standards for 8 contaminants including benzene and vinyl chloride. Identifies 25 additional contaminants as having serious health effects but does not provide emission standards for these contaminants.

The sediment is being removed and transported in the wet. Therefore, emission of air pollutants in concentrations that would trigger these regulations or adversely affect the surrounding population is not anticipated to occur. Refer to N.J.A.C. 7:27 below

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New Jersey Air Toxics Program

Standards for Hazardous Air Pollutants

N.J.A.C. 7:27 Air Pollution Control

Rule that governs the emitting of, and such activities that result in, the introduction of contaminants into the ambient atmosphere. Controls and prohibits air pollution, particle emissions, and toxic VOC emissions

Relevant and appropriate. The sediment is being removed and transported in the wet. Therefore, emission of air pollutants in concentrations that would trigger these regulations or adversely affect the surrounding population is not anticipated to occur. Cap placement has the potential for a small amount of particulate emissions; the design includes implementation of best management practices to control these emissions.

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Noise Control N.J.S.A. 13:1G-1 et seq.

NJAC 7:29

Regulates noise levels for certain types of activities and facilities such as commercial, industrial, community service, and public service facilities. Also provides authority to municipalities to establish noise ordinances.

Relevant and appropriate. While the dredging project does not fit the definition of any type of regulated activity, the regulation is relevant and appropriate. Emergency environmental cleanups are exempted; however, this TCRA is time critical but not an emergency. The allowable levels at a residential property line from 7 am-10pm are 65 dBA continuous, 80 dBA impulsive, and octave band sound pressure levels as stated in the regulation. For residential 10pm- 7 am, 50 dBA continuous and 80 dBA impulsive with octave levels. At industrial, commercial, community service, and public service property lines, the maximum allowable continuous and impulsive levels are the same as daytime residential, with specific octave range levels. The remedial design of dredging activities addresses compliance with this regulation.



TABLE 2-3

**Potential Location-Specific Applicable or Relevant and Appropriate Requirements***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Act/Authority	Citation	Brief Description	Applicability and Anticipated Requirements
Fish & Wildlife Coordination Act 16 U.S.C. 661			
	40 CFR 2 6:302(g)	Requires consultation with the U.S. Fish and Wildlife Service when a Federal department or agency proposes or authorizes any modification of any stream or other water body, and requires adequate consideration to protection of fish and wildlife resources and their habitats.  Wildlife and wildlife resources include: birds, fish, mammals, and all other classes of wild animals and all types of aquatic and land vegetation upon which wildlife is dependent.	Relevant and appropriate to obtain a consultation from U.S. Fish and Wildlife Service to determine if conservation measures are appropriate for this reach of the river bed. It is anticipated that the Passaic River is a migratory pathway, nursery, and forage area for anadromous fish, however, given the relatively large size of the lower Passaic River and the depth and area of the existing channel, the project activities should not affect the ability of migratory species to migrate and/or spawn within the river and utilize their preferred habitats.
Endangered Species Act, Section 7 16 U.S.C. 1531			
		Restricts activities where endangered species may be present, to protect endangered species.	Relevant and appropriate to obtain a consultation from the NJDEP Division of Fish and Wildlife Service to determine if threatened and endangered species or habitats are likely to be present in this reach of the river bed.
National Historic Preservation Act 16 U.S.C. 470			
		Requires federal agencies to take into account the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or is eligible for inclusion in the National Register of Historic Places.	Relevant and appropriate to obtain a consultation from the New Jersey Historic Preservation Office (NJHPO) to determine if historic artifacts are likely to be present in this reach of the river bed. If required by NJHPO, the design will include measures to manage such artifacts if encountered.
Federal Coastal Zone Management Act 16 U.S.C §§ 1456 (Section 307)			
	15 CFR 930.30 Federal Consistency Determination	Administered by National Oceanic and Atmospheric Administration (NOAA) and provides for management of the nation's coastal resources, to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone."	Applicable to dredging. NJDEP would obtain the consistency determination. Refer to attached Table 2-6 listing substantive requirements of the New Jersey Waterfront Development Law and New Jersey Coastal Zone Management (N.J.A.C. 7:7E).
Magnuson-Stevens Fishery Conservation and Management Act, as amended and authorized by the Sustainable Fisheries Act			

	Establishes 10 national standards for fishery conservation and management requires that other federal agencies consult with National Marine Fisheries Service (NMFS) on actions that may adversely affect essential fish habitats, which are defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.”	Applicable. It is believed that the entire Lower Passaic River has been designated as essential fish habitat EFH for various fish species. NMFS is required to recommend measures that can be taken by the consulting federal agency to conserve EFH; therefore a consultation will be initiated. It is expected that the remediation activities will result in a short-term impact to EFH, but will provide a long-term benefit to EFH, federally managed species, and all of the aquatic resources of the Passaic River. However, substantive requirements may include imposition of a dredge window.
Flood Hazard Area Control Act N.J.S.A. 58: 16A-50 et. seq.		
N.J.A.C. 7:13	Delineates flood hazard areas and regulates construction and development within these areas, to minimize potential damage to property, minimize degradation of water quality, protect wildlife and fisheries, and protect and enhance the public’s health and welfare.	Applicable. The Removal Action will occur within a flood hazard area. Refer to New Jersey Waterfront Development Law for substantive measures.
New Jersey Waterfront Development Law (NJSA 12:5-3)		
	Regulates any waterfront development, including sediment removal and fill, at or below mean high water and up to 500 ft from mean high water in the coastal zone and tidal waters of the state. Implemented through Coastal Zone Management (NJAC 7:7E) and Coastal Permit Program Rules (NJAC 7:7)	Applicable to sediment removal, capping, and including the mudflat. Refer to Coastal Zone Management and Coastal Permit Program Rules for substantive requirements.
Coastal Zone Management N.J.A.C. 7:7E	Provides standards for use and development of resources in NJ’s coastal zone including those performed in accordance with the Waterfront Development Law.  Standards for reviewing Federal Consistency Determinations under the Federal Coastal Zone Management Act and Water Quality Certificates in coastal areas under Section 401 of the Federal Clean Water Act.	Applicable. The Coastal Zone Management rules are considered in developing requirements for the Water Quality Certification  Substantive requirements include measures to minimize scouring and resuspension of sediments during dredging and placement of cap materials, slope management, and monitoring upstream and downstream.
Coastal Permit Program N.J.A.C. 7:7	Establishes substantive rules regarding the use and development of coastal resources.	Applicable. The Coastal Permit Program rules are considered in developing requirements for the Water Quality Certification. Substantive requirements include measures to minimize scouring and re-suspension of sediments during dredging and placement of cap materials, slope management, and monitoring upstream and downstream
Tidelands Act (Riparian Lands Leases, Grants and Conveyances [NJSA 12:3-1 et seq.])		

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Requires a tidelands lease, grant, or conveyance for the use of state-owned riparian lands, including sediment removal. The State of New Jersey owns riparian lands flowed by the mean high tide of a natural waterway, except for those lands in which it has already conveyed its interest in the form of a riparian grant.

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Applicable to the sediment removal and backfill. Substantive requirements include that development plans must be prepared by a professional engineer, and must depict the limits of the tidelands instrument.

TABLE 2-4

**RM 10.9 Surface Water Quality Standards***RM 10.9 Removal Action Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Regulation	Requirement and Standards
Statements of Policy	
7:9B-1.5(a)3,4	<p>3. Therefore, point and nonpoint sources of pollutants shall be regulated to attain compliance with the Surface Water Quality Standards human health criteria outside of regulatory mixing zones.</p> <p>4. Toxic substances in waters of the State shall not be at levels that are toxic to humans or the aquatic biota, or that bioaccumulate in the aquatic biota so as to render them unfit for human consumption.</p>
7:9B-1.5(a)9	The Department uses the Integrated Water Quality Monitoring and Assessment Methods developed pursuant to N.J.A.C. 7:15-6.2 to evaluate water quality data and identify waters where water quality does not meet the Surface Water Quality Standards at N.J.A.C. 7:9B as required by Section 303(d) and 305(b) of the Federal Clean Water Act.
7:9B-1.5(c)1,2i,2ii,2iii	<p>1. The natural water quality shall be used in place of the promulgated water quality criteria of N.J.A.C. 7:9B-1.14 for all water quality characteristics that do not meet the promulgated water quality criteria as a result of natural causes.</p> <p>2. Water quality criteria are expected to be maintained during periods when nontidal or small tidal stream flows are at or greater than the MA7CD10 flow, except as provided below:</p> <ul style="list-style-type: none"> <li>i. For acute aquatic life protection criteria, the design flow shall be the MA1CD10 flow;</li> <li>ii. For chronic aquatic life protection criteria for ammonia, the design flow shall be the MA30CD10 flow; and</li> <li>iii. For human health criteria for carcinogens listed at N.J.A.C. 7:9B-1.14(f)7, the design flow shall be the flow which is exceeded 75 percent of the time for the appropriate "period of record" as determined by the United States Geological Survey.</li> </ul>
7:9B-1.5(e)7	7. The Department may require characterization monitoring in NJPDES permits for mercury and PCBs using the USEPA approved method 1631 for mercury (Guidelines Establishing Test Procedures for the Analysis of Pollutants; Measurement of Mercury in Water; Revisions to EPA Method 1631, 40 C.F.R. 136, Fed. Reg. 67:65876, October 29, 2002) incorporated herein by reference, as amended and supplemented, available at <a href="http://www.epa.gov/waterscience/methods/1631.html">http://www.epa.gov/waterscience/methods/1631.html</a> , as supplemented and amended and 1668A for PCBs (Method 1668, Revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS. EPA-821-R-00-002, December 1999) incorporated herein by reference, as amended and supplemented, available at <a href="http://www.epa.gov/Region8/water/wastewater/biohome/biosolidsdown/methods/1668a5.pdf">http://www.epa.gov/Region8/water/wastewater/biohome/biosolidsdown/methods/1668a5.pdf</a> .
7:9B-1.5(h)	(h) A permittee may request that a regulatory mixing zone be established by the Department for applicable criteria except as otherwise provided in this section.
7:9B-1.5(h)1ii	ii. Water quality criteria may be exceeded within the regulatory mixing zone; however, surface water quality criteria must be met at the edge of the regulatory mixing zone;
7:9B-1.5(h)1v	v. Regulatory mixing zones shall be established to assure that significant mortality does not occur to free swimming or drifting organisms;
7:9B-1.5(h)1v(2)	(2) In cases of extended regulatory mixing zones resulting from multiple, conjoined individual regulatory mixing zones, site-specific studies to demonstrate no significant mortality shall be required, taking into account factors including, time of travel, concentration, and the toxicity of the parameters in question;

7:9B-1.5(h)1viii	viii. Regulatory mixing zones, including those for shore hugging plumes, shall not extend into recreational areas, potable surface water intakes (1,500 feet upstream and 500 feet downstream or to the farthest point of backwatering due to the intake, whichever is more protective), shellfish harvesting areas, threatened or endangered species habitat, and other important biological or natural resource areas;
7:9B-1.5(h)1ix	ix. The regulatory mixing zone shall not inhibit or impede the passage of aquatic biota;
7:9B-1.5(h)2ii,2ii(1),2ii(2)	<p>ii. For discharges to tidal water bodies:</p> <p>(1) Regulatory mixing zones for chronic and human health criteria are limited to one fourth of the distance between the discharge point closest to the shoreline and the shoreline during average tidal conditions, or 100 meters, whichever is greater; and</p> <p>(2) Regulatory mixing zones for acute criteria are limited by the distances calculated in accordance with the USEPA "Technical Support Document For Water Quality-Based Toxics Control" USEPA, EPA/505/2-90-001, March 1991, incorporated herein by reference. In no case shall a regulatory mixing zone for acute criteria extend more than 100 meters from the discharge point or include more than five percent of the total surface area of a water body based on critical ambient tidal conditions during low slack, astronomical spring tide for the applicable exposure period.</p>
7:9B-1.5(h)3	3. A regulatory mixing zone study shall be conducted in accordance with a work plan preapproved by the Department. General protocols for conducting mixing zone studies are described in the USEPA "Technical Support Document For Water Quality-Based Toxics Control" USEPA, EPA/505/2-90-001, March 1991. In addition, the following principles apply:
7:9B-1.5(h)4,4i,4ii	<p>4. Instream pollutant concentrations at the boundary of the regulatory mixing zone shall be determined as follows:</p> <p>i. The instream concentrations shall be determined using either a general mass balance equation or a mathematical model, if available; or the information generated during the course of a study as described at (h)2 above.</p> <p>ii. If the regulatory mixing zone is based upon the guidance and procedures in the USEPA "Technical Support Document For Water Quality-Based Toxics Control" USEPA, EPA/505/2-90-001, March 1991, the Technical Support Document will also be used to determine instream concentrations at the boundary of the regulatory mixing zone.</p>
Surface Water Quality Criteria	
7:9B-1.14(c)	(c) Unless site-specific criteria are established at (g) below, State-wide criteria apply for FW2, SE, and SC waters as listed in accordance with (d) through (f) below.
General Surface Water Quality Criteria for FW2, SE and SC Waters: (Expressed as Maximum Concentrations Unless Otherwise Noted) Criteria	
7:9B-1.14(d)3,3i	<p>3. Floating, colloidal, color and settleable solids; petroleum hydrocarbons and other oils and grease</p> <p>i. None noticeable in the water or deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota. None which would render the waters unsuitable for the designated uses.</p>
7:9B-1.14(d)7,7iii	<p>7. Solids, Suspended (mg/L) (Non-filterable residue)</p> <p>iii. None of which would render the water unsuitable for the designated uses.</p>
7:9B-1.14(d)8,8iii	<p>8. Solids, Total Dissolved (mg/L) (Filterable Residue)</p> <p>iii. None which would render the water unsuitable for the designated uses.</p>

7:9B-1.14(d)12,12i,12iii,12iv,12v	<p>12. Toxic Substances (general)</p> <p>i. None, either alone or in combination with other substances, in such concentrations as to affect humans or be detrimental to the natural aquatic biota, produce undesirable aquatic life, or which would render the waters unsuitable for the designated uses.</p> <p>iii. Toxic substances shall not be present in concentrations that cause acute or chronic toxicity to aquatic biota, or bioaccumulate within an organism to concentrations that exert a toxic effect on that organism or render it unfit for consumption.</p> <p>iv. The concentrations of nonpersistent toxic substances in the State's waters shall not exceed one-twentieth (0.05) of the acute definitive LC50 or EC50 value, as determined by appropriate bioassays conducted in accordance with N.J.A.C. 7:18.</p> <p>v. The concentration of persistent toxic substances in the State's waters shall not exceed one-hundredth (0.01) of the acute definitive LC50 or EC50 value, as determined by appropriate bioassays conducted in accordance with N.J.A.C. 7:18.</p>
7:9B-1.14(d)13,13i	<p>13. Turbidity (Nephelometric Turbidity Unit-NTU)</p> <p>i. Maximum 30-day average of 15 NTU, a maximum of 50 NTU at any time.</p>
7:9B-1.14(f) 7 Surface Water Quality Criteria for Toxic Substances (µg/L), Freshwater (FW2) and Saline Water (SE & SC) Criteria, Aquatic and Human Health	

TABLE 2-5

**RM 10.9 Effluent Standards Applicable to Direct Discharges to Surface Water and Indirect Discharges to Domestic Treatment Works**

*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Regulation	Effluent Standard
7:14A-12 Appendix B	Effluent Standards for Site Remediation Projects, SE Waters, Monthly Average (µg/L)
7:14a-12 Appendix B	Effluent Standards for Site Remediation Projects, SE Waters, Daily Maximum (µg/L)

TABLE 2-6

**RM 10.9 Coastal Zone Management Applicable or Relevant and Appropriate Substantive Requirements***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Regulation	Substantive Requirement Discussion
7:7E-3.6 Submerged Vegetation Habitat	Water areas documented as previously supporting rooted and submerged vascular plants are considered to be submerged vegetation special areas. The presence of vascular vegetation in the project area needs to be evaluated. It is anticipated that any effects on vascular vegetation may not be observed, and there would be only low biomass in mudflats. Therefore, no impacts to submerged vegetation habitat are expected and the Removal Action would comply with this policy.
7:7E-3.12 Submerged Infrastructure Routes	There may be submerged private or public utility features within the project area. Ground-intrusive activities will not start until the remediation contractor has notified the New Jersey One Call System and has complied with New Jersey's Underground Facility Protection Act. The contractor will be responsible for the safety, maintenance, protection, and final restoration to the same usefulness, durability, and safety as what existed preconstruction. This applies to not only submerged infrastructure but also all surface and subsurface utilities, facilities, streets, structures, waterways, and other properties at or near the site. Utilities identified will be placed on all plans detailing excavation and stabilization activities to assure the utilities' protection and compliance with the Act to the extent possible. As a result, the Removal Action is expected to comply with this policy.
7:7E-3.15 Intertidal and Subtidal Shallows	Project disturbances may occur within any intertidal and subtidal areas. The goal of the TCRA is to remediate contaminated sediment and remove contaminant mass that is a potential source of contamination to the RM 10.9. Therefore, the proposed project is in compliance with this rule.
7:7E-3.25 Flood Hazard Areas	Even though the project is located within the Flood Hazard Area, no impact on the flood hazard area is anticipated. The proposed project does not require permanent structures that may obstruct tidal and stormwater flows. Temporary changes to drainage patterns occurring during construction will mimic preconstruction conditions, and diversions will be sized to carry frequent storm events. Following sediment removal, the areas will be backfilled with a cap which will provide no net fill. The project will not permanently alter any drainage patterns. Refer to the Flood Hazard Area Control Rules (N.J.A.C. 7:13) and the associated substantive permit requirements. This project complies with Section 7:7E-3.25, since no permanent development will occur within the Flood Hazard Area creating an obstruction that could increase flood elevations.
7:7E-3.26 Riparian Zones	The New Jersey Flood Hazard Area Control Rules 7:13-4.1(a) 4 state that a riparian zone exists along every regulated water. The Riparian Zone includes the land and vegetation within each regulated water, as well as the land and vegetation within a certain distance of each regulated water. As defined in N.J.A.C. P:13-4.1, the Riparian Zone is 50 feet landward from the top of the stream bank. Onsite activities within the riparian zone include the construction support area. No fill material will be stockpiled in the onsite Riparian Zone. The construction support area is currently disturbed and contains sparse vegetation as a result of the compacted soil and subsurface materials. In addition, soil erosion and sediment control measures will be implemented to protect the surrounding Riparian Zone beyond the work area. The channels will be restored with a protective cap. The cap's top elevation will be no higher than the existing sediment surface, allowing flow in and out of areas similar to preconstruction conditions. The removal of any vegetation from the mudflat will be limited to the workspace and areas will be allowed to revegetate naturally following remediation.
7:7E-3.36 Historic and Archaeological Resources	The New Jersey and National Registers of Historic Places, and the NJDEP Landscape Project mapping, which contains the boundaries of Critical Environmental and Historic Sites of the New Jersey State Development and Redevelopment Plan, will be reviewed. Additionally, there will be consultation with the New Jersey Historic Preservation Office (NJHPO) to confirm that the project complies with state and federal policies regarding historic and archaeological resources. No impact to cultural resources is anticipated.

7:7E-3.38 Endangered or Threatened Wildlife or Plant Species Habitats	There will be consultation with NJDEP New Jersey Natural Heritage Program and the National Marine Fisheries Service (NMFS) to confirm that the project complies with all state and federal policies and conditions regarding endangered or threatened wildlife. The NMFS will be contacted to confirm compliance with the Endangered Species Act, the Fish and Wildlife Coordination Act, and the Magnuson-Stevens Fishery Conservation and Management Act.
7:7E-3.39 Critical Wildlife Habitats	There will be consultation with NJDEP to confirm that the project complies with all state and federal policies and conditions regarding critical wildlife habitats.
7:7E-3.41 Special Hazard Areas	Special hazard areas include areas with a known actual or potential hazard to public health, safety, and welfare, or to public or private property, such as where hazardous substances, as defined at N.J.S.A. 58:10-23.11b-k, are used or disposed of, including adjacent areas and areas of hazardous material contamination. Typically, approvals from NJDEP's Division of Solid and Hazardous Waste are obtained before beginning hazardous substance investigations or cleanup activities at contaminated sites. The LPR site is a listed CERCLA site and therefore is known to contain potentially hazardous materials. The purpose of this project is to remediate the hazardous materials contained within the RM 10.9 site. Investigations have been conducted to indicate contamination levels and to provide data for designing remediation procedures. Contaminated sediments will be handling using best management practices (BMPs) to reduce health and safety hazards to the extent practical.
7:7E-3.47 Geodetic Control Reference Marks	The LPRSA RIFS has established control that meets the stated regulation and those controls will be utilized for all surveys conducted.
7:7E-3.50 Lands and Waters Subject to Public Trust Rights	Lands and waters subject to public trust rights are tidal waterways and their shores, including both lands now or formerly below the MHW line, and shores above the MHW line. (See the section discussing Subchapter 8, Public Trust Rights (7:7E-8.11) for detailed information regarding public trust rights and how the project is in compliance with this policy.)
Subchapter 4. General Water Areas	
7:7E-4.7 New Dredging.	General Water Areas are all water areas located below either the spring high water line or the normal water level of non-tidal water that are subject to the Coastal Zone Management rules and to Special Area rules. There are 22 General Water Areas identified in the regulations and the following sections summarize potential ARARs.  New dredging is the removal of sediment that does not meet the definition of maintenance dredging at N.J.A.C. 7:7E-4.6. Maintenance dredging is the removal of accumulated sediment from previously authorized and legally dredged navigation and access channels, marinas, lagoons, canals, or boat moorings for the purpose of maintaining a previously authorized water depth and width for safe navigation. Maintenance dredging would not apply to this project because the purpose of this dredging is not for maintaining a previously authorized water depth and width for safe navigation. The dredging of sediment associated with the TCRA is strictly for removing contaminated sediments from the waterway. As required with any "new dredging", environmental impacts will be minimized to the maximum extent feasible; the dredge area is reduced to the minimum extent practical; dredging is anticipated to have no adverse impacts on groundwater resources; and no dredging will occur within 10 feet of any wetlands. There are no wetlands in the project area, and dredging shall be accomplished consistent with conditions as appropriate to the dredging method to reduce the escape of contaminated material to the extent possible, and to prevent potential adverse environmental impacts to the surrounding area. Dredging will be performed carefully using a clamshell bucket, and implementing best management practices, as described in Section 4. Because the sediment and soil excavation methods will limit downstream turbidity, limit the suspension of contaminants, reduce the bioavailability of contaminants, and improve the health of the water body, the Removal Action is in compliance with this policy.

7:7E-4.10 Filling	By definition, “filling” is the deposition of material including, but not limited to, sand, soil, earth, and dredged material, into water areas for the purpose of raising water bottom elevations to create land areas. This policy is not applicable to the project because the purpose of placing material on the site is not for raising the original water bottom elevations or to create additional land. Although the technical definition is not applicable, a cap designed to reduce the bioavailability of contaminants will be placed within the stream channel as part of restoration activities to provide a substrate for the benthic community rehabilitation. The project is in compliance with this rule because the purpose of the fill is not for raising water bottom elevations or for creating new land areas.
Subchapter 6. General Location Policies	
7:7E-6.2 Basic Location Rule	The project is in an area that is environmentally degraded. The site is presumed not to be considered as exceptional wildlife habitat. This is a known contaminated site. This project will improve public health and safety related to the site because contaminated sediments will be removed and replaced with new, clean sediments. Therefore this project complies with this subchapter.
7:7E-6.3 Secondary Impacts	Secondary impacts are the effects of additional development likely to be constructed as a result of the approval of a particular proposal. Secondary impacts can also include traffic increases, increased recreational demand, and any other offsite impacts generated by onsite activities that affect the site and surrounding region. Remediation of this site is not likely to stimulate secondary development because of its location within the water body areas. Rather, the objective is to restore the water body to its designated uses.
Subchapter 8. Resource Rules	
7:7E-8.4 Water Quality	The Lower Passaic River is categorized as an SE3 water body. The designated uses of SE3 water bodies per NJAC 7:9B-1.12 are: 1. Secondary contact recreation; 2. Maintenance and migration of fish populations; 3. Migration of diadromous fish; 4. Maintenance of wildlife; and 5. Any other reasonable uses. Because the removal action objectives include reducing the bioavailability of the contaminants, the New Jersey surface water quality standards may be considered as chemical-specific ARARs. The project is in compliance with this subchapter because any potential impacts to surface water will be minimized by the best management practices and sediment control techniques. The overall remediation project is designed to improve long-term water quality in the area.
7:7E-8.11 Public Trust Rights	Public trust rights to tidal waterways and their shores established by the Public Trust Doctrine include public access, which is the ability of the public to pass physically and visually to, from, and along lands and waters subject to public trust rights, as defined at N.J.A.C. 7:7E-3.50, as well as to use these lands and waters for recreational activities. Public trust rights also include the right to perpendicular and linear access. Public access ways and public access areas provide a means for the public to pass along and use lands and waters subject to public trust rights. Because this is a CERCLA action, formal public access will not be provided and the work area in the water will be delineated. The nature of the project will be the cleanup of hazardous materials. No structural development is proposed.

## Relevant Site Conditions

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### 3.1 Area Description

The LPRSA encompasses the 17.4 miles of the Passaic River below the Dundee Dam, its tributaries, and the surrounding watershed that hydrologically drains below the Dundee Dam (**Figure 1-1**). Adjacent land use is predominantly industrial in the lower RMs (near Newark Bay) and starts to become more commercial, residential, and recreational near RM 4. Land use is increasingly residential and recreational above RM 8. The LPRSA has been industrialized and urbanized for more than two centuries; it has served as the receiving environment for industrial and municipal waste discharges since the nineteenth century. However, the river is now being used increasingly for recreational activities, such as boating and fishing, as parks and boat ramps are actively being restored or newly established. Natural habitat areas along the shoreline, including wetland and mudflat habitats, are limited to small patches or isolated areas.

The RM 10.9 Study Area extends, bank to bank, between RM 10 and RM 12 of the LPRSA (**Figure 1-1**). The RM 10.9 Sediment Deposit Area (**Figure 1-2**) extends approximately 2,380 ft from RM 10.65 to RM 11.1, along an inside bend of the LPR upstream of the DeJessa Park Avenue Bridge; and downstream of the Lyndhurst-Delaware Rail Bridge (RM 11.4); it is adjacent to Riverside County Park in Bergen County, across from a mixed residential and industrial area, and immediately downstream of the confluence of Third River and the LPR.

The RM 10.9 Removal Area is a 5.6-acre area, within the RM 10.9 Sediment Deposit Area, which is bounded on the west by the eastern navigational channel limits and bounded on the east by the mean high water elevation (**Figure 1-2**). The Removal Action will take place within the RM 10.9 Removal Area of the RM 10.9 Sediment Deposit Area and RM 10.9 Study Area.

### 3.2 Geology

The project site is within the physiographic province known as the Piedmont, which covers the central portion of New Jersey and is approximately one-fifth of the state. It is underlain by folded and faulted sedimentary rocks of Triassic and Jurassic age and igneous rocks of Jurassic age. The Piedmont is described as a “low rolling plain” (Dalton, 2003). The depth to this bedrock surface is approximately 50 ft near the removal area and rises sharply to near ground surface just west of Highway 21.

Within the northern part of the Piedmont province, the bedrock is overlain by surficial deposits made up of artificial fill, alluvial and estuarine sediments of postglacial age, and glacial sediments (Stanford, 2001). The terminus of Wisconsin glaciation is approximately 30 miles south of the site. Glacial lakes and streams within the region produced sediment, including stratified sand, gravel, silt, and clay. The till was deposited by the retreat of the glacial ice and can be up to 250 ft thick north of the site, these glacial lake sediments can be up to 50 ft thick and at elevations greater than the site. The glacial lake sediments below the site are usually less than 30 ft thick. Beneath these glacial sediments there may also be a till that is poorly sorted, non-stratified sediment directly deposited by the glacial ice. This till is described as reddish brown to light reddish brown silty sand to sandy clayey silt containing some to many sub-rounded and sub-angular pebbles and cobbles and a few sub-rounded boulders (Stanford, 2001). This till may be 10 to 20 ft thick at the site.

The post-glaciated sediments of the region include anthropogenic fill and sediment in salt marshes, in freshwater swamps, and in river flood plains and channels deposited after the glacial retreat (Stanford, 2001). Post-glaciated sediments at the site include the Lower Passaic Terrace Deposits that make up the surface sediments east of Riverside Park. This deposit contains fine-to-coarse sand, some silt and pebble gravel; and can be light-reddish brown, light gray, or very pale brown in color. It is moderately to well-sorted, stratified, and can be as much as 40 ft thick (Stanford, 2001). This thickness is on the order of 20 ft east of Riverside Park. The Riverside Park and the RM 10.9 Removal Area are composed of alluvium deposits that contain sand, silt, pebble-to-cobble gravel, and minor clay that can be a dark brown, gray, and or reddish-brown in color and contains variable amounts of

organic matter. These deposits can be up to 25 ft thick. The RM 10.9 Characterization Program identified sediments that were composed of approximately 2 percent gravel, 30 percent sand, and 68 percent silt and clay.

### 3.3 Groundwater

Groundwater in the region can occur in three different geologic formations: underlying bedrock and glaciated and non-glaciated fluvial deposits. Flow within unconsolidated sediments always migrates from areas of high hydraulic head to areas of low hydraulic head or from areas of recharge to areas of discharge. These deposits are the glacial lake Delawanna Deposits (Stanford, 2001), which can vary in amounts of silt, clay, fine sand, and sandy silt till. Silt and clay lake-bottom deposits have the lowest permeability, with estimated hydraulic conductivities of  $3.5 \times 10^{-9}$  to  $3.5 \times 10^{-7}$  cm/sec; fine sand and silt have slightly higher estimated hydraulic conductivities, of  $3.5 \times 10^{-7}$  to  $3.5 \times 10^{-5}$  cm/sec; and the alluvium deposits have a range of  $3.5 \times 10^{-3}$  to  $3.5 \times 10^{-1}$  cm/sec. A seepage velocity has been estimated to be on the range of 250 to 500 cm/year. A field program is being developed and will be implemented to further evaluate the potential seepage velocity through the river bed. This value will be used in the cap design modeling discussed in Section 7.2.

Bedrock of the Passaic Formation rises sharply on the west side of the LPR, forming a relatively impermeable barrier to the west. A small outcrop of the formation occurs approximately 2,500 ft west of the LPR. The upper portion consists of shale and sandstone. Water generally is present in weathered joint and fracture systems in the upper 200 or 300 ft (Barksdale et al., 1958). Groundwater in the Passaic Formation is often unconfined in the shallower, more weathered part of the aquifer and confined or semi-confined in the deeper part of the aquifer. The primary groundwater flow within the Passaic Formation is through secondary permeability resulting from a series of interconnected fractures. The upper part of the Passaic Formation aquifer system is typically unconfined. However, near-surface bedrock units are highly weathered. Silt and clay derived from the weathering process typically fill fractures, thereby reducing permeability (Michalski, 1990). This relatively low permeability surface zone reportedly extends 50 to 60 ft into the formation. This groundwater flow from the bedrock would then need to flow through the approximately 20 ft of the Rahway till and 20 ft of the glacial lake deposits before reaching the alluvium sediment that makes up the river bed. The Rahway till, the surficial deposit for much of the area west of the LPR, will further reduce the amount and rate of groundwater flow from west of the LPR.

## 3.4 In Situ Physical and Chemical Characteristics

### 3.4.1 Chemical Properties

To characterize the nature and extent of sediment contaminants of the RM 10.9 Sediment Deposit Area, cores were advanced and samples were taken from 54 locations as part of the 2011 RM 10.9 Sediment Characterization Program. Of these 54 locations, 25 fall within the RM 10.9 Removal Area. An additional 15 locations were sampled as part of the RM 10.9 QAPP Addendum A sediment collection program to characterize sediments along the shore. Of these 15 locations, only 5 at the northern end are within the RM 10.9 Removal Area. The LRC, SSP, and benthic sampling programs each have one location within the RM 10.9 Removal Area. The sampling results from these programs are summarized in **Table 3-1** and detailed tables and figures in **Appendix A**.

**Table 3-1** presents as a function of depth below the sediment surface the maximum, minimum, and average sediment concentrations for select COPCs measured within the RM 10.9 Removal Area. Four depth intervals are characterized in the table: 0 to 2.5 ft below ground (sediment) surface (bgs), representing the dredge interval of 0 to 2 ft bgs; and 2.5–3.5 ft bgs, 3.5–5.5 ft bgs, and 5.5 ft bgs to native, representing the material that will be left in place after the sediment removal and capping activities are completed. The highest 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and total PCB concentrations were found in the dredge interval (0–2.5 ft bgs) at 35,600 ng/kg and 35 mg/kg, respectively. The maximum total PCB concentration measured within the removal area, 35 mg/kg, does not exceed the Toxic Substances Control Act (TSCA) regulatory threshold of 50 mg/kg. The complete RM 10.9 data set can be found in the *River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area* (CH2M HILL and AECOM, 2012).

### 3.4.2 Physical Properties

Physical properties were also analyzed during the 2011 RM 10.9 Sediment Characterization Program. These data

were limited to the sediments above and just into the native clay layer. **Table 3-2** summarizes the results for grain size, percent moisture, percent solids, specific gravity, and total organic carbon (TOC) for depth intervals of 0–2.5, 2.5–3.5, and 3.5–5.5 ft bgs. The estimated grain size distribution for the dredged sediments, which is based on results from the 0–2.5 ft bgs depth interval, is approximately 1.7 percent gravel, 29 percent sand, and 69 percent silt and clay. The average of percent solids is approximately 50 in the top 2.5 ft of sediments. Specific gravity of the dredged sediments will likely range from 2.3 to 3.0 based on the 2011 sediment characterization program data.

## 3.5 Hydrodynamics<sup>2</sup>

Portions of the LPR below Dundee Dam are a stratified estuary. The LPRSA receives inflows of marine (salt) water from Newark Bay and fresh water from the Upper Passaic River (above Dundee Dam) and its tributaries, surface runoff, combined sewer overflows, and stormwater outfalls (below Dundee Dam). The less dense freshwater flows downstream over the tidally influenced salt water that, on the flood tide, moves upstream from Newark Bay. The exact extent of the salt “wedge” (i.e., the wedge-shaped intrusion of salt water into the estuary that slopes downward in the upstream direction) is dependent on the phase of the tide and the volume of fresh water flowing downstream. Limited data from the RM 10.9 Sediment Deposit Area are available.

A hydrodynamic model<sup>2</sup> of the RM 10.9 Removal Area of the LPR was developed with high spatial resolution to predict the distribution of bottom shear stresses in this area under a variety of flow conditions and especially during significant flow events. Among the features and processes represented in the model are the secondary flow patterns in the river bend, the flow distribution across the LPR varying from the channel to the shoals, and upstream flow contribution coming from the Third River. Accordingly, a Delft-3D hydrodynamic model with a split domain consisting of four grids was developed; it had a high-resolution grid of approximately 13 m by 7 m around the area of interest and much lower resolution upstream of RM 11.5. The open source Delft-3D modeling system was chosen for its computational speed, its state-of-the-art ability to represent the essential physics of the system, and ease of model setup.

The high-resolution multibeam bathymetric and single-beam data for shoal areas that lay beyond the extent of multibeam coverage of the area were gathered in July–August 2011 (before Hurricane Irene) (Gahagan & Bryant Associates 2011) and used to develop the model bathymetry. The model included as its upper boundary the discharge at Dundee Dam and as its lower boundary the water levels at RM 10.1 from the model developed for the LPR/NB modeling program. The inflow from the Third River was scaled to the Passaic River discharge. The Physical Water Column Monitoring (PWCM) data collected in fall 2009 from acoustic Doppler current profiler (ADCP) stations at RM 10.2 and RM 13.5 was used for calibrating the model, which was done by varying the bottom roughness and eddy viscosity parameters. The calibrated model used the Manning roughness formulation with horizontal roughness coefficients of  $0.023 \text{ m}^{1/3}/\text{s}$ . The horizontal and vertical eddy viscosities were set to  $10^{-2} \text{ m}^2/\text{s}$  and  $10^{-5} \text{ m}^2/\text{s}$  respectively. The calibration period included a 6,000 cfs discharge event towards the end of the ADCP deployment. The model during this period reproduces very accurately the observed velocities. The model was further validated by comparing model results to velocity data collected in October and November 2011 using four different moored ADCPs between RMs 10.8 and 11.1. This was a period of relatively low to average flow, with the Passaic discharge never exceeding 3,500 cfs. The model for this period also reproduces quite accurately the observations. In addition, the velocity transects measured from boat-mounted ADCPs as part of the same data collection effort were used to qualitatively verify the cross-shore velocity distribution predicted by the model.

The velocity profiles across the river section were measured using boat-mounted ADCP at a different (mostly higher) vertical and horizontal resolution than the model representation of the system. These measurements represent averages over these horizontal and vertical bins, just as model-predicted velocities are averages over each grid cell and sigma level. Because the cross section in the model is defined by a discrete number of points, and differences between the real cross section and the model cross section should occur, a relatively small

<sup>2</sup> Moffat and Nichol modeled the Hydrodynamic Field Investigation data collected as part of the RM 10.9 Characterization Program (CH2M HILL and AECOM, 2012); the summary in this subsection of the model findings was provided by Canizares (2012).

difference in the location where the model predicts the highest and lowest velocities across the river and where these are observed would result in a significant error, if a direct quantitative comparison is performed. Therefore, as is done for most projects, and in particular in the hydrodynamic model report of the LPR/NB model prepared by HQI for USEPA, a qualitative comparison of velocity distribution plotted from data and the closest model output is used to assess the validity of the model results.

This model was then applied to simulate a 1-month period that included the Hurricane Irene event, which produced a 25,000 cfs discharge in the Passaic River on August 31, 2011. The downstream boundary near RM 10.9 used modeled water levels from the ECOM hydrodynamic model of LPR-Newark Bay for water year 2011, and the upstream boundary by hourly average of discharge at Dundee Dam measured by the U.S. Geological Service (USGS) gauge. The model required a 1.2-second (s) time-step to produce stable results under the high-current conditions observed during Hurricane Irene. The maximum total shear stress predicted by the model is as high as 26 pascals (Pa) in the channel near RM 10.9, and the channel bottom velocities predicted were up to 2 m/s.

Analysis for the 100-year flood flow used the standard extreme value analysis using peak annual flow records spanning from 1896 to 2012 at the USGS Little Falls gauge station to estimate flow return periods. A Fisher-Tippett Type II probability distribution was found to best describe these data. Based on this analysis, the Hurricane Irene flow (20,800 cfs at Little Falls) corresponded to a near 80-year return period event, with 100-, 200-, and 500-year events being roughly 22,000 cfs, 25,000 cfs, and 29,000 cfs at Little Falls, respectively. The 35,800 cfs event in 1903 was the consequence of a dam failure as reported by the USGS. Because of this reason it was not included in the CPG's extreme value analysis. For extreme events beyond the 100-year flow, it seems reasonable to expect a small incremental effect on model velocities, as much of that increased flow volume could be expected to translate to more flooding of shoals/banks because of the limited capacity of the existing river cross section. The flow during Hurricane Irene could be considered to be close to a 100-year event, while a 32,000 cfs flow at Dundee Dam is close to a 500-year event. A synthetic 32,000 cfs event corresponds roughly to a 500-year return period. The values of maximum total shear stress and bottom velocities within the RM 10.9 removal area predicted by the model for this synthetic event were 34 Pa and 2.3 m/s, respectively. The maximum total shear stress and bottom velocities for the 100-year flow are approximately 23 Pa and 1.8 m/s, respectively.

Depth-weighted velocity and water depths for the river for a 1-year event (6,000 cfs) are provided in **Figure 3-1** and **Figure 3-2**, respectively. Depth-weighted velocity and water depths for a 100-year flow of 22,000 cfs are provided in **Figure 3-3** and **Figure 3-4**, respectively. This hydrodynamic information is used in Section 7 to determine the appropriate armor layer for an estimated 100-year flow event. **Figure 3-5** provides the shear stresses associated with the 100-year flood conditions. The shear stresses for a synthetic 32,000 cfs event (close to a 500-year event) are provided in **Figure 3-6**. At USEPA's request, the impact of designing cap for a more intense storm than the 100-year return period flood was also evaluated. The 500-year return period flood was utilized for this additional evaluation.

## 3.6 Climate Conditions

Climatological factors such as precipitation, wind, and freezing can affect the project's implementation by restricting the work schedule or necessitating temporary shutdown of operations. Climate data will be collected onsite during implementation to address specific needs of the project. This information will provide the possible conditions for planning purposes. Climate data for Newark, NJ, approximately 7 miles south/southwest of RM 10.9, are summarized in **Table 3-3**. This table presents monthly 30-year normal baseline statistics from 1981 to 2010. The average high temperatures in the summer months range from the mid to high 80s. Heat advisories are not uncommon during the summer months, when temperatures can reach 100°F. Average monthly rainfall ranges from 2.9 to 4.7 inches (in.). Average low temperatures below freezing generally occur from December through February. Ten years of hourly meteorological data (1981 through 1990) were obtained from the Newark Airport Meteorological Station to generate wind rose diagrams. Prevailing winds over this period are generally from the southwest with average wind speeds ranging from 4.0 to 4.6 m/s (9.0 to 10.3 miles per hour). During project implementation an on-site meteorological station will provide real time monitoring of the conditions.

## 3.7 Bridges

There are 19 bridges between Dundee Dam and the mouth of the LPR, with 17 bridges falling between the RM 10.9 Removal Area and the mouth of the LPR. The location of each of these bridges is provided in **Figure 3-7**. The type, horizontal clearance, and vertical clearance at low water level are provided in **Table 3-4**. A more detailed table is provided in **Appendix B**, which in addition to the clearance data also includes the bridge owner, contact information, opening coordination requirements, and if any construction/maintenance is currently scheduled or planned for during next year's construction season.

There are no bridges in the RM 10.9 Removal Area. However, these bridges represent a key navigational consideration for sizing barges and other construction support vessels that must travel from RM 10.9 to the Newark Bay area. It is assumed that seven of the bridges will need to be opened at the beginning and end of the project to allow the dredge plant and associated equipment access to the removal site (i.e., mobilization and demobilization). At all other times the barges and support vessels will be sized to clear the bridges without them having to be opened.

TABLE 3-1

**RM 10.9 Removal Area Summary of Chemical Parameters***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Analyte	Conc.	Depth Interval											
		0 to 2.5 ft bgs			2.5 to 3.5 ft bgs			3.5 to 5.5 ft bgs			5.5 ft bgs to native		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
2,3,7,8-TCDD	ng/kg	35,600	2.1	8,874	29,800	1.0	9,478	18,750	0.35	3,493	6,230	0.50	498
Total PCB	mg/kg	35	0.0048	11	28	0.00012	10	25	0.000013	4.5	13	0.000011	2.0
Mercury	mg/kg	24	0.023	8.9	19	0.0078	7.6	17	0.0043	6.0	83	0.0010	7.0
Benzo(a)pyrene	mg/kg	7.8	0.015	3.6	7.3	0.012	4.0	18	0.0015	4.8	59	0.00019	5.6
HMW PAH	mg/kg	110	0.16	31	64	0.017	32	188	0.0031	37	539	0.00015	35
LMW PAH	mg/kg	25	0.049	5.7	14	0.00046	6.4	62	0.00011	9.2	144	0.000066	9.3

Data Sources: River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area (CH2M HILL and AECOM, 2012); additional delineation data from RM 10.9 QAPP Addendum A (AECOM, 2012a) and the LPR Supplemental Sampling Program.

Values represent detected data from sediment cores only (i.e., no grab samples) with duplicate samples averaged prior to data compilation.

2,3,7,8-TCDD, 2,3,7,8-tetrachlorodibenzo-p-dioxin;

Total TEQ, total toxicity equivalency quotient

PCB, polychlorinated biphenyl;

HMW PAH, high molecular weight polycyclic aromatic hydrocarbon;

LMW PAH, low molecular weight polycyclic aromatic hydrocarbon;

ft bgs, feet below ground (sediment) surface;

ng/kg, nanograms per kilogram;

mg/kg, milligrams per kilogram.

TABLE 3-2  
**RM 10.9 Removal Area Summary of Physical Parameters**  
*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Physical Characteristic	Depth Interval								
	0.0–2.5 ft bgs			2.5–3.5 ft bgs			3.5–5.5 ft bgs		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Grain size									
% Cobble	—	—	—	—	—	—	—	—	—
% Gravel	37	0.0	1.7	24	0.0	1.7	26	0.0	3.3
% Sand	98	2.5	29	88	2.6	39	88	11	44
% Silt and clay	98	2.0	69	97	3.0	59	89	4.5	53
Other									
% Moisture	213	11	111	147	15	85	122	15	71
% Solids	91	27	49	89	40	56	88	45	62
Specific gravity	3.0	2.3	2.5	2.7	2.3	2.5	2.7	2.3	2.5
TOC	12	0.34	5.9	9.5	0.13	5.6	9.0	0.050	4.8

Data Source: *River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area* (CH2M HILL and AECOM, 2012).  
Values represent data from sediment cores only (i.e., no grab samples) with duplicate samples averaged prior to data compilation.  
ft bgs, feet below ground surface; Max., maximum; Min., minimum; Avg., average; %, Percent; TOC, total organic carbon.

TABLE 3-3

**Local Climate and Wind Rose Data***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily high (°F)	72	74	86	97	99	102	105	105	100	89	81	76
Average high (°F)	39.4	42.9	51.3	62.6	72.8	82.1	86.6	84.7	77.3	66.0	55.3	44.1
Average low (°F)	25.1	27.5	34.2	44.3	53.9	63.8	69.2	68	60.3	48.5	39.6	30.2
Daily low (°F)	5	14	23	30	49	55	67	61	54	44	31	10
Precipitation (in.)	3.53	2.88	4.18	4.20	4.09	4.02	4.76	3.70	3.82	3.60	3.65	3.80
Snowfall (in.)	8.9	9.5	4.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.4
<b>Wind Rose Summary</b>												
Average Wind Speed (m/s)	4.89	5.05	5.41	5.17	4.59	4.05	4.55	4.05	4.03	4.13	4.81	4.67
Average Direction	W	N/NW	W/NW	NW	S/SW	SW	SW	SW	SW	SW & N/NE	W	W/NW

Source: Local Climate Data 1981–2010 Normals, NOAA (2012). Wind rose data from 1981 to 1990 were generated using WRPLOT View Version 7.0.0, Lakes Environmental Software, available at <http://www.webLakes.com> (2012). Met data were obtained through the WRPLOT View software, which is linked to the Meteorological Resource Center, <http://www.webMET.com> (2012). Newark Airport Station #14734 met data.

TABLE 3-4

**RM 10.9 Removal Project Bridges***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Bridge Name	River Mile	Bridge Type	Max. Horizontal Clearance	Max. Vertical Clearance
Central Railroad of NJ ( <i>not in use</i> )	0.91	Lift (dismantled)	145	NA
Lincoln Highway Bridge (US-1 Truck)	1.57	Lift deck	300	45 (140)
Pulaski Skyway (Routes 1 & 9)	1.75	Fixed span	520	140
Point-No-Point Conrail	2.33	Swing	103	21
NJ Turnpike Bridge (I-95)	2.41	Fixed span	352	105
Jackson Street Bridge (Frank E. Rodgers Blvd S./County Rd 697)	4.37	Swing	72	20
Amtrak Dock Bridge	4.75	Lift deck	200	29 (143)
Penn RR at Market Street	4.75	Draw	75	21
Penn RR at Center Street	4.75	Draw	80	10
Bridge Street Bridge	5.41	Swing	80	12
Morristown Line RR Bridge / (Newark-Harrison) Erie Swing Bridge	5.57	Swing	77	20
Stickel Bridge (I-280)	5.61	Lift deck	200	40 (140)
Clay Street Bridge (Central Ave)	5.83	Swing	75	13
Fourth Ave Conrail Bridge	6.07	Single-leaf truss bascule (fixed open)	126	12
Erie/Montclair-Greenwood Lake RR Bridge (West Arlington Street Bridge)	7.81	Fixed rail (decommissioned swing)	48	40
Rutgers (Route 7) Bridge	8.53	Lift deck	—	13
DeJessa Park Avenue Bridge	10.37	Open truss swing	—	11
Lyndhurst-Delaware Rail Bridge	11.4	Opening swing	—	30
Rutherford Avenue (Route 3) Bridge	11.65	Double leaf bascule	—	40

Source: Lower Passaic River Commercial Navigation Analysis Rev 2 (USACE, 2010); Lower Resolution Coring Characterization Summary, Lower Passaic River Study Area RI/FS (AECOM, 2011).  
Maximum vertical clearance is measured at low tide. If a lift bridge, vertical clearance in parenthesis refers to clearance when bridge is open.

Maximum horizontal clearance is measured between abutments or piers of bridge

NA, not applicable, since bridge was removed. —, data not available.

RM data was sourced from Table 2-5 of LRC report, for consistency (AECOM, 2011).



# Dredging

The dredging design includes the removal of contaminated sediments from the RM 10.9 Removal Area, barge transport of contaminated sediment to the stabilization facility, and environmental monitoring.

## 4.1 Design Criteria

The design criteria were developed in accordance with the following documents:

- *Action Memorandum/Enforcement: Determination of Need to Conduct a CERCLA Time Critical Removal Action at the Diamond Alkali Superfund Site, Lower Passaic River Study Area, River Mile 10.9 Removal Area* (USEPA, 2012b) (the Action Memorandum/Enforcement)
- *Lower Passaic River Study Area RM 10.9 Removal Action and Pilot Tests: Statement of Work* (USEPA, 2012c)

## 4.2 Estimated Volume of Dredged Material

### 4.2.1 Sediment

The target dredge depth used to remove material from the RM 10.9 Removal Area will be 2 ft below the existing sediment surface, plus or minus a vertical dredge tolerance of 4 in. Removal to the 2 ft target depth equates to approximately 18,000 yd<sup>3</sup> of contaminated sediment. An illustration of target dredge elevation and the associated vertical dredge tolerance is provided as **Figure 4-1**. The basis for the removal volume is provided in **Appendix B** and shown on the design engineering drawings provided in **Appendix C**. Dredging specifications are provided in **Appendix D**.

**Figure 4-2** shows existing site conditions with the river center line divided into stations every 50 ft for reference. The area north of Station 31+00 will be dredged to native material because the relatively steep slope here will not sustain cap material. The estimated amount of material to be removed between the original 2 ft depth cut and the native material is an additional 1,000 yd<sup>3</sup>. Target dredging volumes will be further evaluated and refined in the Final Design.

The existing site conditions, design post-dredge bathymetry, and example cross sections for the 2 ft removal depth are provided in **Figures 4-2, 4-3, and 4-4**, respectively.

### 4.2.2 Debris

Visual observations of the sediment surface during typical low tide conditions indicate that debris of various types and sizes (i.e., concrete debris, rocks, tree limbs) will be encountered during the removal operations. While this debris may temporarily slow down the dredging operations it is not anticipated to significantly affect the overall daily production rate. The debris will be removed with the excavator using either a clamshell or conventional bucket dependent on the size/shape of the debris. The removed debris will be placed in sediment barges for transport to the designated off-loading facility. If large debris (over 3 ft in any one dimension) is encountered, the plan is for it to be segregated to one end of the barge to minimize delays during unloading.

A geophysical survey or demonstration dredging has not been conducted for the removal area so the amount of potential debris has not been quantified. However, given the relatively shallow dredge depth (2 ft) a working assumption is that nominally 5 percent (by volume) of the dredged sediment will contain debris over 4 in. As part of a utility survey, there will be some geophysical survey work conducted which will identify large debris if present.

### 4.2.3 Utilities

Two known water utility lines and a solid wire cable have been identified as crossing the removal area footprint, as indicated in **Figure 4-5**. Field investigations which include a third-party utility search and sub-bottom profiling are currently being undertaken in order to determine the depths of these and potentially other (currently

unknown) utilities which may be located in the removal area. Once the details of utility crossings are further determined, the appropriate offsets for the dredging works will be established. These offsets will be included in the final design. In addition, the contractor will be responsible for conducting a pre-construction utility check.

## 4.3 Dredge Performance Criteria

### 4.3.1 Equipment Type and Size

#### 4.3.1.1 Dredge

Dredging will be performed with shallow draft vessels capable of removing all the sediment from the water side of the RM 10.9 Removal Area in water depths of approximately 2.5 to 4 ft, depending on the type and size of barges utilized. The dredging work will be carried out using a hydraulic excavator situated on a spud barge. The excavator will be equipped with a 3 to 5 yd<sup>3</sup> environmental clamshell bucket (see next section) specifically designed for removal of contaminated sediment at approximate in situ conditions while minimizing turbidity.

#### 4.3.1.2 Environmental Bucket

Contaminated sediment within the RM 10.9 Removal Area will be dredged using an environmental clamshell bucket capable of making a level cut during the closing cycle (see **Figure 4-6**) that meets the performance requirements of the technical specifications. The environmental dredge bucket will be equipped with hardware that allows the bucket to be operated by using positioning and machine-control software to meet the horizontal and vertical accuracy requirements. In addition, the software will allow the operator to control bucket penetration depth to avoid overfilling and minimize the resuspension of sediment. The environmental dredge bucket will have sensors to confirm that the bucket completely encloses the dredged sediment and captured water. The environmental dredge bucket will not have teeth and will be equipped with escape valves or vents that close when the bucket is withdrawn from the water.

The cut depth of the bucket will be such that a theoretical bucket fill of approximately 80 percent of the bucket volume is achieved. This will cause minimal spill and turbidity. For a 5 yd<sup>3</sup> environmental bucket, this equates to a cut depth of approximately 12 in. For the purposes of the dredge designs it is assumed that the sediment will be removed to the target depth of 2 ft in two to three lifts and the average cut depth will be approximately 10.7 in. This average cut depth results in a quantity of water within each bucket grab of approximately 31 percent (1.56 yd<sup>3</sup>).

#### 4.3.1.3 Barges

The dredged material and debris will be transported to the off-loading facility in shallow draft barges capable of operating in approximately 2.5 to 4 ft of water and clearing the 17 bridges downstream of the RM 10.9 Removal Area during low tide. For the purposes of this design, it is assumed that three 250 yd<sup>3</sup> shallow draft barges 130 ft long and 35 ft wide with a vertical clearance (when empty) of approximately 8 ft will provide sufficient capacity to match the required daily production rate of the dredge and that the barge fleet will consist of a minimum of nine barges: three at the dredge site, three at the unloading facility, and three empty barges awaiting transport back to the dredge site.

### 4.3.2 Position Accuracy and Dredge Tolerance

The dredging accuracy and progress will be managed by software capable of monitoring the x, y, and z positions of the bucket in real time. The software will provide the dredge operator a real-time view of the barge and bucket position. The software will display the surface (derived from existing hydrographic survey data) and provide real-time feedback showing current horizontal position, current elevation, final project elevation, target elevation, and current bucket elevation. Horizontal positioning accuracy will be  $\pm 1.0$  ft, and the vertical positioning accuracy will be  $\pm 4$  in.

### 4.3.3 Production Rate

The dredge production rate will be dependent on the size of bucket, size of barges, hours of operation, and operational parameters (e.g., cycle time, excess water, equipment up time, time to change barges). The parameters used to estimate the dredge production rate are provided in **Table 4-1** and, as shown in **Table 4-2**, the

projected unrestricted dredging rate can vary from 293 to 924 yd<sup>3</sup>/day, depending on the bucket size (3 yd<sup>3</sup> or 5 yd<sup>3</sup>) and whether the operation is restricted to 12 hours per day rather than 24 hours per day due to noise/neighborhood restrictions. The calculations to support these production rates are provided in **Appendix B**. The capacity for stabilizing dredge material is anticipated to be a minimum of 2,000 yd<sup>3</sup>/day and, therefore, is not considered to be a constraint to the dredging production rate.

For planning purposes, it is assumed that dredging will be performed with a 5 yd<sup>3</sup> environmental bucket and that operations will be permitted only 12 hours/day based on the current stabilization operation, resulting in a daily production rate of 462 yd<sup>3</sup>.

TABLE 4-1

**Dredge Production Rate Parameters***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Parameter	Value
Environmental bucket size	3 to 5 yd <sup>3</sup>
Average excess water per bucket grab	31% of in-bucket dredge material volume
Average bucket cycle time	2.5 minutes
Average dredge uptime	65%
Average barge change-out time	20 minutes
Hours of operation per 12-hour shift	10

TABLE 4-2

**Comparison of Potential Dredging Production Rates***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Process	Production Rate (yd <sup>3</sup> /day)
Maximum dredging production (3 yd <sup>3</sup> bucket, 12 hrs/day)	293
Maximum dredging production (3 yd <sup>3</sup> bucket, 24 hrs/day)	587
Maximum dredging production (5 yd <sup>3</sup> bucket, 12 hrs/day)	462
Maximum dredging production (5 yd <sup>3</sup> bucket, 24 hrs/day)	924
Stabilization treatment rate (12 hrs/day)	2,000

### 4.3.4 Dredging Operations

To obtain the best results with environmental clamshell buckets, operational protocols are followed. To avoid suspending sediment from the creation of a pressure wave in front of the bucket, the bucket is not allowed to free fall through the water column. With the vented environmental clamshell bucket, most of the sediment loss during the dredging cycle occurs either at the river bottom when the bucket is closed and hoisting begins or at the water surface when the vents flap to adjust to the sudden pressure change as the bucket breaks the surface. To minimize sediment loss, the bucket is lowered and hoisted in a controlled manner. Lowering and hoisting speeds

of approximately 1 ft/s generally provides good results, and at no time should this speed exceed 2 ft/second. When hoisting, the operator pauses at the water surface to allow excess water in the bucket to drain and equalize pressures. Swinging the bucket to the material barge with the bucket vents positioned at the water surface and then raising the bucket to the dump height works better than immediately hoisting the bucket to the dump height and then swinging it to the barge through the air.

Before hoisting the bucket from the river bottom, the operator checks the control system to verify that the closure switches indicate the bucket has sealed. If debris or foreign objects prevent the bucket from closing, two approaches are generally used. Because sediment released near the riverbed settles back to the bottom quickly and does not break apart and disperse like material released high in the water column, the operator can reopen the bucket immediately above the riverbed, relocate the bucket slightly in the x-y plane, and reclose the bucket. This procedure often relocates the foreign object into the bucket, allowing the bucket to close. Rocks, bricks, tires, fishing tackle, and similar objects are generally handled with this technique. With large sunken logs, pilings, and similar long or awkwardly shaped objects, there is sometimes no alternative to grabbing the object with the bucket and dumping it into the material barge as rapidly as possible to minimize the amount of time that sediment leaks from the unsealed bucket.

It is important that the dredge operator match the target depth shown by the dredging software as closely as possible. The environmental clamshell buckets are designed to be completely filled at a specific penetration depth, usually between 1 and 1.5 ft. If the bucket penetration is too deep, excess sediment extrudes through the vents and is resuspended as the bucket is lifted through the water column. Therefore, care must be taken to avoid overfilling the bucket. Excess water from dredging will be contained during barge transport and removed at the off-loading facility for subsequent handling and treatment prior to discharge.

For environmental dredging with mechanical equipment, generally accepted best management practices (BMPs), including resuspension management are described in Section 4.4. Dredging is planned to be performed from up-current areas to down-current areas with the barge situated parallel to the shore, as practicable. Typically, dredging proceeds from shallow to deep water in order to best manage resuspension. However, due to the removal area being exposed at low tide, the dredging operations will be required to begin in the deeper water and progressively proceed towards the shallower water in order to maintain sufficient draft for the marine equipment.

### 4.3.5 Material Transport

Dredged material will be transported in shallow draft barges from the dredge site downriver to a treatment facility's off-loading location located within the Newark Bay area. This operation will be constrained by the vertical and horizontal clearances of several bridges located between the removal site and the treatment facility. These clearances are directly affected by the tidal fluctuations and river stage. Dredge material transport is assumed to be a 24-hour/day operation to accommodate expected logistical constraints related to barge and equipment coordination, and tidal limitations for under-bridge passage. The maximum vertical clearance and passage time are determined by low tide conditions and the allowable time to safely clear the constraining bridges between RM 4.75 and RM 6.07. This projected safety window is limited to about 2 hours during each tide cycle (low tide +/- 1 hour). Therefore, assuming a tow speed of 1 mph, one-way barge separation of 10 minutes and 2-way vessel traffic coordination such that full and empty barges pass on the river where horizontal clearance is approximately 200 ft (RM 5.61) the logistics of clearing this 1.32 mile stretch of river in 2 hours is achievable for 6 barges (3 empty and 3 full). For planning purposes, it is assumed that material barges approximately 130 ft long and 35 ft wide with a capacity of 250 yd<sup>3</sup> will be used. These barges have a vertical clearance of approximately 8 ft when empty and will be able to meet the minimum vertical clearance of the bridges at low tide. The tugs/work boats will be sized so that they are not a constraint on the dredging operations. A minimum of nine barges will be used for the material transport operations. It is assumed that three barges will be available daily at the dredge site for loading, three barges will be staged at the unloading facility daily for unloading, and three empty barges will be available for transport back to the dredge site.

### 4.3.6 River Operations

Dredging activities will be upriver of most existing in-river commercial activities and are not anticipated to adversely affect these river operations. Several High School rowing clubs may row through the RM 10.9 Removal Area. The competitive high school rowing season should be complete by June 15. There will still be other recreational rowers and a few fishing boaters passing through the area. A layout of the dredging operations is provided as **Figure 4-7**. Barges and dredges transiting river working areas will be required to coordinate with ongoing in-river operations and recreational water activities. Only half of the river will be used for dredging/capping operations and this area will be designated with highly visible warning buoys, lights, and floating and shoreline signage to direct the recreational boaters/ rowers. Details will be provided in the Site and Community HSPs. Therefore, to minimize the impact on harbor and river operations/activities, dredging works will require close cooperation with other river users, particularly when barges are transporting material to the designated off-loading facility. The contractor will be responsible for notifying the Newark Port Authority, USACE, and other affected parties.

### 4.3.7 Hours of Operation

Dredging operations will be assumed to be a 12-hours-per-day, 6-days-per-week operation. One day per week will be reserved for maintenance activities. To accommodate height restrictions associated with several of the bridges and the tidal influences, the dredge material transport operations will be assumed to be a 24-hours-per-day, 6-days-per-week operation.

### 4.3.8 Operability, Reliability, and Maintainability

- Bucket efficiency of approximately 69 percent
- Maintenance will be allowed 1 day per week
- Average operational uptime of dredging-related facilities is presumed to be 65 percent

## 4.4 Resuspension Management

This section presents the rationale for managing sediment resuspension primarily with operational controls during sediment removal operations.

### 4.4.1 Relevant Site Conditions and Impact on Resuspension Risks

The site conditions for RM 10.9 are favorable for minimal sediment resuspension and transport of the contaminants for the following reasons:

- River velocity is relatively low (0.82 ft/sec) during typical flow conditions (<1,200 cfs annual average flow), which are anticipated to be the general conditions during the majority of the proposed construction timeframe; thus, the transport of resuspended material from the dredge area will be reduced.
- Bathymetry is relatively shallow with an average water depth of less than about 4 ft, significantly reducing the typical vertical heights through which resuspension occurs.
- Free product contamination is not known to be present, and the COPCs are hydrophobic; thus, the mechanism of contaminant release is limited to resuspended sediment.

### 4.4.2 DREDGE Model

The DREDGE Model developed by the USACE was used to make an assessment of the potential environmental impacts from the proposed dredging operation for RM 10.9. DREDGE estimates the mass rate at which bottom sediments become suspended into the water column as the result of mechanical dredging operations and the resulting suspended sediment concentrations. The DREDGE estimates are combined with information about site conditions to simulate the size and extent of the resulting suspended sediment plume and the resulting total suspended solids estimates.

Many types of mechanical dredges exist, but the DREDGE Model only supports the dredge types for which sufficient resuspension data has been collected to support the development of a limited source generation model—cutterhead and open bucket dredges. The RM 10.9 TCRA will be utilizing an environmental bucket that

will resuspend less sediment than open bucket dredges; therefore, the output from the model is considered conservative.

The input parameters used for the DREDGE model are provided in **Table 4-3** and a summary of the results are provided in **Table 4-4**. The complete DREDGE Model output results are provided in **Appendix B**.

TABLE 4-3

**DREDGE Model Input Parameters***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Parameter	Inputs
River flow conditions	Average flow (1,200 ft <sup>3</sup> /sec) 1 year maximum flow (6,000 ft <sup>3</sup> /sec)
Average velocity	Average flow (0.25 m/sec) 1 year maximum flow (0.5 m/sec)
Dredge production rate	86 yd <sup>3</sup> /hr
Dredge bucket size	5 yd <sup>3</sup>
Bucket cycles per hour	17
Seconds per cycle	150 sec (2.5 minutes)
Total volume removed	18,000 yd <sup>3</sup>
Loss rates (% of total mass) <sup>a</sup>	- 0.5% - 1.0%
Average depth of water	Average flow (1.4 m) 1 year maximum flow (1.8 m)
Settling particle size	50 µm
Particles less than 74 microns	54%
Diffusion rate	Average flow (98.44 cm <sup>2</sup> /sec) 1 year maximum flow (143.51 cm <sup>2</sup> /sec)

<sup>a</sup>Palermo et al. (2008) concluded that “the conservative characteristic resuspension factor for mechanical dredges with environmental buckets without overflow is about 0.5 percent.” One percent was also used as an upper bound.

TABLE 4-4

**DREDGE Model Results for RM 10.9***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Sediment Release Rate	Estimated TSS Concentration from Dredging Operations (mg/L)							
	Average Flow				1 Yr Max Flow			
	200 m	400 m	600 m	1,000 m	200 m	400 m	600 m	1,000 m
0.5%	10.327	2.62	0.767	0.076	8.766	4.161	2.28	0.796
1%	19.62	4.977	1.458	0.145	16.655	7.905	4.332	1.512

The Hudson River Project has an Advisory Level for TSS concentrations in the near-field of 100 milligrams per liter (mg/L) above ambient (upstream) conditions at the near-field monitoring station located 300 m downstream of

the dredging operation. DREDGE Model results indicate that the RM 10.9 dredging operations would meet a similar water quality standard. However, in order to be protective of the river environment and further minimize the potential impact of resuspended sediment, a silt curtain system in addition to other BMPs will be utilized for the project. The use of silt curtains will result in the majority of TSS settling out at the dredging location, thus reducing the TSS in the near-field.

#### 4.4.3 Proposed Resuspension Control Approach

Based on the existing river conditions and the relatively low estimated impact of dredging operations on the river, it is proposed that the following BMPs be implemented and evaluated to control turbidity:

- Deploy a localized heavy-duty silt curtain close to the active dredging areas
- Utilize a closed, watertight (i.e., environmental) clamshell
- Maximize the size of the “bite” taken by the clamshell
- Slowly withdrawing the clamshell through the very short water column
- Prohibit barge overflow or rinsing sediments off the sides/gunwales of the barge
- Maintain expeditious movement of the closed bucket to the receiving barge after completing a cut to reduce water leakage from the clamshell bucket into the river to the extent practicable.
- Prohibit “re-handling” or stockpiling of material on the river bottom
- Prohibit raking for debris removal
- Avoid grounding of marine vessels and allowing water levels to rise before attempting to free grounded vessels.
- Minimize the number of trips by support vessels
- Restrict the draft of workboats and barges
- Restrict navigational speeds
- Restrict the size and power of workboats
- Prohibit any type of prop-washing

The proposed water quality monitoring to be conducted is described in Section 4.6.

#### 4.4.4 Silt Curtains

In order to manage potential resuspension which occurs during dredging operations, all removal activities will be conducted within a silt curtains/boom system. These silt curtain/ boom systems are designed specifically for silt control in rivers, inter-coastal waterways, bays, and harbors and will be deployed around the perimeter of the dredge plant as shown on **Figure 4-7**. The cell/moon pool will be suspended from the flotation barges using either chains or cables. This alignment represents the minimum perimeter for the silt curtain. The contractor may choose revise the alignment, based on the capabilities of their equipment.

The perimeter of the silt curtain system will be marked by buoys. The silt curtain skirt will be long enough to direct resuspended sediment toward the bottom, and booms will be located sufficiently far from dredging activities that any potentially suspended materials will reach the surface before the current carries them beyond the boom.

##### 4.4.4.1 Description

The silt curtain systems for RM 10.9 are designed to provide sufficient residence time to allow the larger sediment particles to settle out of suspension within the area being dredged. These silt curtain systems must be flexible and adaptable to both the environmental conditions of the river as well as all activities associated with dredging. These silt curtains will be constructed of PVC sheeting that is weighted on the bottom and suspended from marine-quality flotation buoys. Floating, flashing marker lights designed for use with turbidity control curtains will be installed.

#### 4.4.4.2 Installation

The silt curtain/boom systems will be connected directly to the dredge plant and the material hopper barge such that at all times the dredging operations are conducted within the silt curtain system. In order to avoid having to “dig in” to install the silt curtain system at locations where the water depth is less than 3 ft, the silt curtain system will be secured with anchors.

The alignments of the silt curtain/boom systems will be established by the contractor, who will determine the locations of all the anchors taking into consideration the capabilities of dredge plant and tidal fluctuations. The silt curtain/boom systems will be loaded onto work boats and transported to the designated area. Once on station, the silt curtain/booms will be lowered into the water and anchored to either the marine vessels or anchors. After dredging an area, the silt curtains are removed in the reverse order of installation prior to repositioning the dredge plant.

#### 4.4.5 Rationale for No Sheet Pile Wall

Sheet pile walls can be used for many different reasons during sediment removal projects. The primary purpose is to hold adjacent non-excavated materials from entering the removal area. In limited situations, sheet pile walls may help to contain resuspended sediment during the removal process. The excavation at the RM 10.9 is only 2 ft deep and immediately adjacent to the bank so there is no need for structural support from a sheet pile wall. While concentrations of COPCs in the sediment to be removed at RM 10.9 are elevated, they are 100 to 1,000 times lower than the Tierra Phase I project (see **Table 4-5** for a select set of COPCs), where sheet pilings were required. Given the vast difference in concentrations, sheet pile walls are not needed as a chemical containment measure at RM 10.9. The overall effectiveness of a sheet pile wall to further reduce resuspension beyond implementation of BMPs is uncertain because of the following factors:

- Near-shore sheet pile installation would require pre-dredging (with associated resuspension) in order to provide sufficient draft for marine equipment to place portions of the sheet pile wall.
- Installation and removal of a sheet pile wall will generate resuspension.
- Sheet pile installation (including pre-dredging for installation) and removal would increase the duration of in-river work, resulting in an increased opportunity for resuspension.

The installation of sheet piling would also narrow a significant portion of the river’s width for a 4- to 5-month duration, exacerbating any river flooding and its effects while the sheet piling was in place.

Therefore, the relatively small potential impact of resuspended material on areas outside the RM 10.9 Removal Area, the uncertain benefit of installing a sheet pile wall, and the potential for adverse flood-related impacts do not warrant the use of a sheet pile wall to control resuspension.

TABLE 4-5  
Comparison of Key COPCs Sediment Concentrations for the Tierra Phase I and RM 10.9 Projects

Comparison of RM 10.9 and Tierra Phase I Sediments		Average Concentration (When Detected)		Ratio of Phase I COPC Concentrations to RM 10.9 COPC Concentrations
COPC	Units	RM 10.9	Tierra Phase I	
2,3,7,8-TCDD	ng/kg (ppt)	8,874	338,000	38
Total PCB	mg/kg (ppm)	11.6	9.3	0.8
4,4-DDT	mg/kg (ppm)	0.20	648	3,240
2,4-DDT	mg/kg (ppm)	0.0025	159	63,600
Chlorobenzene	mg/kg (ppm)	0.0008	2,449	3,061,250

Comparison of RM 10.9 and Tierra Phase I Sediments		Maximum Concentration Detected		Ratio of Phase I Maximum COPC Concentrations to RM 10.9 Maximum COPC Concentration
COPC	units	RM 10.9	Tierra Phase I	
2,3,7,8-TCDD	ng/kg (ppt)	35,600	9,410,000	264
Total PCB	mg/kg (ppm)	35	87	2
4,4-DDT	mg/kg (ppm)	17	21,990	1,294
2,4-DDT	mg/kg (ppm)	0.024	5,200	216,667
Chlorobenzene	mg/kg (ppm)	0.0017	72,000	42,352,941

## 4.5 Waterside Site Requirements

The Township of Lyndhurst has indicated that the adjacent park lands should not be used for staging, processing, and disposal of sediments removed from the river. However, it is assumed that a small portion of land adjacent to the removal area will be available for staging construction support trailers and a temporary dock. The CPG field facility in Rutherford may also be used for support activities. All other waterside facilities required for equipment and material will be located offsite at the contractor's designated property. The tentative area available for setting up these trailers is shown in **Figure 4-7** and is subject to final approval from the Township of Lyndhurst. There is a boat ramp at this location that could also be upgraded for the transfer of personnel to and from the dredge vessel. The dredging contractor would be responsible for all utility connections and infrastructure improvements necessary to support these facilities.

## 4.6 Environmental Constraints

### 4.6.1 Water Quality

Dredging will be undertaken in a manner that will minimize resuspension of dredged sediment in the LPR. Calculations in Section 4.4 show that resuspension should be within acceptable standards. However, monitoring will be performed during dredging activities to assure that dredging BMPs are effectively reducing resuspension. The objectives of the dredge monitoring activities include the following:

- Monitor the water quality for excessive resuspension during dredging operations
- Quantify select COPCs levels in the water column during dredging operations.
- Comply with applicable NJ Surface Water Quality criteria

Section 2 identifies NJAC 7:14A, Surface Water Discharge Criteria, and NJAC 7:9B, Surface Water Quality Standards, as relevant and appropriate requirements. In particular, NJAC 7:14A-12, Effluent Standards Applicable to Direct Discharges to Surface Water and Indirect Discharges to Domestic Treatment Works, and NJAC 7:14A-13, Effluent Limitations for Discharge to Surface Water Permits, have been considered. However, due to the degraded nature of the LPR both upstream and downstream of RM 10.9, monitoring for constituents other than the most significant compounds of concern could yield confusing and inconclusive results. Therefore, the Removal Action will include monitoring of turbidity (NTU), total suspended solids (TSS), and select COPCs at locations adjacent to the dredging operations. When no dredging is being undertaken, monitoring may be suspended until the dredging activity resumes.

#### 4.6.1.1 Baseline Turbidity and TSS Monitoring

Turbidity monitoring has been used on many dredging projects as a real time indicator of resuspension due to dredging. A site-specific relationship between turbidity and TSS must be established. Data collected for the LPRSA RIFS Physical Water Column Monitoring program at RM 10.2 provides a preliminary indication that a good

correlation between turbidity and TSS exists. Surface water monitoring of turbidity (NTU) and TSS will be performed to collect data that will be used to determine the project specific turbidity to TSS correlation. Prior to the commencement of dredging activities, four stationary buoyed monitoring locations will be installed upstream and downstream of the RM 10.9 Removal Areas to establish average non-dredging baseline conditions as well as measuring turbidity during dredging. The monitoring locations will be the following:

1. Turbidity buoy #1: a fixed background location upstream of the dredging operations at approximately 3,300 ft (1,000 m) upstream of the removal area.
2. Turbidity buoy #2: upstream at the edge of the dredging area of influence, located approximately 1,000 ft (300 m) of the dredging operations. The monitoring location will be moved to always remain approximately 1,000 ft upstream of the dredging location.
3. Turbidity buoy #3: downstream at the edge of the dredging area of influence, located approximately 1,000 ft (300 m) downstream of the dredging operations. The monitoring location will be moved to always remain approximately 1,000 ft downstream of the dredging location.
4. Turbidity buoy #4: a fixed downstream location of the dredging operations at approximately 3,300 ft (1,000 m) downstream of the removal area.

**(Figure 4-8).** Upstream and downstream baseline measurements will begin at least one month prior to dredging activities and cease after completion of capping.

The turbidity monitors will be installed at these locations at half the water depth to collect data every 15 minutes for assessing turbidity levels. During this month of baseline monitoring TSS samples will be collected at the four buoy locations daily to verify the turbidity/TSS relationship so that the real-time turbidity monitors can be the initial resuspension indicator.

#### 4.6.1.2 Initial Dredging Monitoring

The turbidity-to-TSS relationship identified in the baseline monitoring for dredging activities will be verified. TSS samples will be collected at the four buoy locations and mobile locations during the first 48 hours of dredging. During this phase of monitoring, a two-person crew in a small vessel (e.g., a jon boat) will monitor the extent of the turbidity plume downstream of dredging activities using the same type of turbidity monitor used at the four stationary locations. TSS samples will be collected from the water depth of greatest turbidity as measured at the midpoint of the total water column depth. Sampling will start at the dredge and continue at 100 ft intervals in the direction of current flow within the center of the visible suspended solid plume until the downstream point is reached where turbidity levels return to no more than 110 percent of current background levels as determined by turbidity buoy #1. Surface water TSS sample/turbidity monitoring locations will be surveyed and recorded. Establishing the turbidity correlation curve will require a minimum of 20 TSS samples collected over a range of turbidity levels using the method described above. These samples will be paired with the corresponding in situ turbidity measurements to establish the dredging site-specific relationship between TSS and turbidity. Additional paired samples may be required based on the range of concentrations obtained and the correlation curve derived from the initial set of paired TSS/turbidity results.

Once established, the correlation curve will be used to estimate the TSS concentration from the measured turbidity value, and turbidity will be measured continually during dredging operations at both stationary locations, described above. Confirmation of the TSS/turbidity relationship will be conducted at least once a month during the duration of the project by collecting water samples for TSS analysis from the water depth of greatest turbidity at three locations, starting at the dredge and continuing at 100 ft intervals, resulting in three samples per month.

The locations of these monitoring sites are shown in **Figure 4-8**. **Table 4-6** provides an overview of the monitoring points. The farthest upstream and downstream monitoring sites are intended to reflect the general background conditions of the LPR (depending on tidal and river stage conditions) and to not be affected by the dredging operations. The monitoring sites adjacent to and within the removal area are intended to reflect conditions due to the removal and capping operations.

### 4.6.1.3 Resuspension Monitoring

After the initial 48-hours of dredging monitoring for turbidity and TSS, resuspension monitoring will begin. This monitoring is performed by the real-time turbidity monitoring at the 4 buoy locations on fifteen minute intervals monitored in real-time. The following action levels will be implemented:

- If the turbidity “**trigger level**,” or early warning criterion, of 35 nephelometric turbidity units (NTU) above background is exceeded over four consecutive readings (i.e., 60 minutes), at turbidity buoy #2 the dredge operator will be notified and directed to evaluate dredging BMPs as identified in Section 4.4.3.
- If the turbidity “**action level**” of 70 NTU above background is exceeded over four consecutive readings (i.e., 60 minutes), at turbidity buoy #3 dredging will be suspended until the turbidity level returns to below the 80 NTU action level for four consecutive readings (i.e., 60 minutes), unless it can be demonstrated that dredging is not the cause of the exceedance.
- If dredging is suspended, water column samples will be collected at the buoy location where the trigger level occurred for the target COPCs (2,3,7,8 TCDD, Total PCBs, mercury).

In addition to the real time turbidity monitoring, field measurements will be made of turbidity and TSS samples collected at the turbidity buoys #2 and #3 and at a three location transect including west, center, and east channel locations. This information will be used as check on real-time monitoring.

TABLE 4-6

#### Removal Action Surface Water Monitoring Details

RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey

Monitoring Location	Type of Monitoring Point	Monitoring Frequency	Description of Location
Turbidity buoy #1	Real time turbidity (NTU)	Continuous—15 minute	Fixed point 3,300 ft upstream of removal area
	TSS sample collection	Baseline—once daily; initial 48 hrs—every 4 hrs	
Turbidity buoy #2	Real time turbidity (NTU)	Continuous—15 minute	Maintain upstream of dredging operation 1,000 ft
	TSS sample collection	Baseline—once daily; initial 48 hrs—every 4 hrs	
Turbidity buoy #3	Real time turbidity (NTU)	Continuous—15 minute	Maintain downstream of dredging operation 1,000 ft
	TSS sample collection	Baseline—once daily; initial 48 hrs—every 4 hrs	
Turbidity buoy #4	Real time turbidity (NTU)	Continuous—15 minute	Fixed point 3,300 ft downstream of removal area
	TSS sample collection	Baseline—once daily; initial 48 hrs—every 4 hrs	
Transects (west, center, east channels)	Field turbidity(NTU) and TSS sample collection	3 times a week	Dredging project area—various locations
Trigger level buoy location	Water column select COPCs and TSS sample collection	Action level events or once a week	Dredging project area

The details with respect to sample collection, laboratory analysis, and recording are provided in the Construction Environmental Monitoring QAPP Addendum (**Appendix E, under development**).

#### 4.6.1.4 Spill Response Plan

A spill response plan will be implemented for the containment, cleanup, and removal of any oil spills and other oil releases that may occur as a result of project activities. As part of this spill response plan, mobile spill response kits will be available at the river-to-land unloading location(s), adjacent to the sediment stockpiling area, and in

required site vehicles. The spill kits will include the following:

- 50 pads Bale Oil HD (or equivalent)
- 1 Pillow Oil HD (or equivalent)
- 1 Boom Oil K-Sorb (or equivalent)
- 50 lbs of FloorSweep (or equivalent)
- 10 bag disposal units
- 1 plug and dike unit

In the event of a significant release of oil/fuel or other pollutant into the river, these steps will be followed:

- The affected area will first be made safe and secure.
- Operations will be suspended, and any potential for further spills will be prevented (where possible), and the existing spill contained.
- Recovery and clean up of the contaminant will be undertaken.
- Relevant statutory authorities, including the USEPA and NJDEP, will be notified, as will nearby and/or downstream stakeholders who may be affected.
  - To report environmental incident in NJ, call 24-Hour Environmental Incident Hotline: 1-877-927-6337 (1-877-WARNDEP)
  - EPA Superfund—Emergency Response
  - National Response Center: 1-800- 424-8802
  - New Jersey Department of Environmental Protection (NJDEP)—Site Remediation and Waste Management Emergency Response, NJ Office of Emergency Management
  - Response measures implemented will be monitored and assessed for effectiveness in controlling the pollution event and likelihood of preventing a repeatable event

## 4.6.2 Air Quality

Dredging activities using BMPS will be performed to prevent any offensive odor or particulates from being emitted beyond the limits of the RM 10.9 Removal Area. Air emission sources are regulated by both the USEPA and the NJDEP and the substantive requirements of these regulations will be completed. Preliminary emissions calculations suggest that dredging activities will not result in emissions exceeding the USEPA or NJDEP reporting thresholds or applicable regulatory requirements associated with project-related emissions sources.

### 4.6.2.1 Dust

It is expected that there will be no significant dust impacts attributable to dredging and related activities, including those onshore because the dredged material has a high moisture content, thereby reducing its potential to generate dust during handling. Continual visual monitoring of conditions, including dust, will further mitigate any dust risk.

### 4.6.2.2 Exhausts

Dredging equipment, cranes, self-propelled barges, tug boats, and other operating equipment at the LPR site will be a source of exhaust emissions. All equipment will be fitted with exhaust systems and maintained in a proper and efficient manner.

## 4.6.3 Noise

All dredging activities will be completed in such a manner that the noise levels do not exceed the maximum noise contribution limits established for the project. As described in Table 2-2, NJAC 7:29 is considered a relevant and appropriate requirement, although this type of activity does not fit the definition of a regulated activity under that rule. The dredging will be conducted to achieve the noise limitations stated therein. It is expected that all noise levels at the nearest sensitive receptors will be below the site-specific noise criteria (**Table 4-7**).

TABLE 4-7

**Noise Limits [Limits and Locations to Be Discussed with NJDEP—in Progress]***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Noise Level Monitoring Station	Location	Daytime (maximum hourly average)	Evening (maximum hourly average)
1	North perimeter 100 ft upstream of removal area on east shore	75 dBA	65 dBA
2	South perimeter 100 ft downstream of removal area on east shore	75 dBA	65 dBA
3	Center perimeter of removal area on east shore	75 dBA	65 dBA

Day is defined as the period from 7:00 a.m. to 6:00 p.m., Monday to Saturday; evening is defined as the period from 6:00 p.m. to 10:00 p.m.

The following measures will be taken to prevent noise levels from exceeding the limits:

- All equipment will be operated and maintained in a proper and efficient manner to reduce the potential for noise and other issues
- Daily prestart equipment inspections will be undertaken and include inspection of key noise attenuation devices (e.g., mufflers).
- Any defects that are reported will be scheduled for repair.

Additional noise control measures are not considered warranted based on current available information. This information includes dredging experience to date, initial setting for dredging and related works, and the site's being most of the time at least 1,000 ft from the nearest residential area except for the narrow north removal area which is closer. No blasting or installation of sheet piles is anticipated as part of dredging operations.

All activities that could possibly exceed the noise criteria specified above will only be undertaken within the hours specified below:

- Throughout the 24-hour period for a maximum of 12 hours between Mondays and Saturdays
- At no time on Sundays or public holidays

## 4.7 Project and Community Health and Safety

A project-specific Health and Safety Plan has been developed to include the dredging and in-river material transport operations. A number of potential occupational health issues are associated with the proposed dredging operations that are addressed in the Project Health and Safety Plan (**Appendix F**).

The dredging and material transport operations have the potential to impact the local community surrounding the dredging operations and possible up and down the river. It is very important that the community is informed of the work to be completed and the plans in place to protect the public during these activities. A Community Health and Safety Plan will be developed in conjunction with the necessary agencies and public groups. An outline of such a plan is provided in **Appendix G**.

## 5 Rationale for Not Conducting Sediment-Washing Pilot Test(s)

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In August 2012, bench-scale treatability tests were performed by two sediment-washing technology vendors (BioGenesis and Pear Technology) using bulk sediment samples collected in accordance with the *Lower Passaic River Study Area River Mile 10.9 Characterization Quality Assurance Project Plan Addenda A* (AECOM, 2012b) and *B* (CH2M HILL, 2012c). Preliminary results for key site constituents are summarized below and in the technical memorandum *RM 10.9 Removal Action—Sediment Washing Bench-Scale Testing Report, Lower Passaic River Study Area—CERCLA Docket No.02-2012-2015* (CH2M HILL, 2012d) included as **Appendix H**.

The bench-scale tests were performed to evaluate the potential effectiveness and implementability of sediment washing as a treatment and beneficial reuse option for RM 10.9 Removal Area sediments. In order to qualify for beneficial reuse, the treated sediment is expected to meet residential criteria for dioxins/furans, PCBs, PAHs, and other constituents. The sediment-washing bench-scale tests were not able to achieve the degree of removal required to meet the stringent beneficial reuse concentration objectives for dioxins/furans, PCBs, and PAHs in the RM 10.9 Removal Area sediments. Therefore, the treated sediment would not be eligible for beneficial reuse and would need to be further treated or disposed of at a permitted landfill, resulting in an estimated unit cost of \$700 to \$900 per cubic yard.

Sediment washing without the benefit of an economical reuse or disposal option (e.g., disposal at a Subtitle D versus Subtitle C landfill) is not a cost-effective approach to treating and disposing of RM 10.9 Removal Area sediments. Sediment-washing technology will not be pursued by the CPG for the RM 10.9 Removal Area sediments. The CPG has determined that both stabilization and mechanical dewatering are significantly more cost-effective treatment alternatives for the RM 10.9 Removal Area sediments than sediment washing, and both will be further evaluated as part of the removal action design.

## SECTION 6

6

# Sediment Treatment: Stabilization

The sediment treatment design package includes specific design criteria for all sediment activities that occur from the time the contaminated sediment is removed from the barge to the time the stabilized material is loaded into trucks for transport to the offsite landfill for disposal. The sediment stabilization treatment steps include the following:

1. Pump the supernatant from the barge to water holding tanks/barges
2. Remove the dredged material from the barge
3. Screen the dredged material to remove debris and oversize material
4. Convey the sediment to the pug mill mixer
5. Stabilize the sediment by mixing it with Portland cement
6. Transfer treated sediment to a storage/staging area
7. Load the treated sediment into haulage trucks or rail cars for transport to the approved offsite disposal facility

The mass balance/process flow diagram for the stabilization operations is provided in **Figure 6-1**.

## 6.1 Design Criteria

The key design criterion associated with the treatment operations is amending the dredged material so that it passes the paint filter test and can be transported to a designated offsite disposal facility. The treated material would also be required to meet the acceptance criteria of the designated offsite disposal facility, subject to USEPA's offsite disposal policy.

## 6.2 Preliminary Design Elements

The following information is to be reviewed and assessed by the potential stabilization contractors, who will determine the suitability of the proposed approach. Dredge sediment-processing facilities located in Kearny, NJ, and Elizabeth, NJ, are being considered for the project. The preliminary design elements of the stabilization treatment operations consist of the following:

- Barge dewatering
  - Once the material barge has been secured at the off-loading facility, any freestanding water within the barge will be removed with submersible trash pumps; the water will be transferred to onsite storage tanks for storage prior to off-site treatment and discharge or disposal
- Coarse material separation
  - Large debris will be removed from the barge, stockpiled at the treatment facility, assessed, and decontaminated (if necessary)
  - Once the large debris has been removed, the sediment will be offloaded to a feed hopper, where material over 4 in. will be separated with a grizzly and/or shaker screen; as with the large debris, the screened material will be segregated, stockpiled, assessed and transported offsite for disposal
  - The undersized sediment will be then conveyed to the pug mill system for stabilization
- Stabilization
  - The weigh feeder on the conveyor belt will transmit the weight of the incoming sediment to the variable-speed screw conveyor on the cement silo
  - Cement will be added to the sediment at an average of 10 percent by weight of wet sediment. This ratio will be adjusted as needed to ensure that the stabilization design criteria are achieved.
  - The cement and sediment will be mixed in the pug mill for the time required to achieve thorough mixing
  - The treated sediment will be discharged directly to the storage facility using a stacker conveyor system

- Loading
  - The treated sediment will be loaded onto trucks or rail cars for transportation to the offsite disposal facility

### 6.2.1 Barge Water Removal

Any excess water that can be decanted and pumped off the barges, will be removed and transferred to the facility water storage tanks. The maximum volume of free water expected to be removed is based on an assumed bucket efficiency of approximately 69 percent; therefore, approximately 31 percent of each barge load is assumed to be free water beyond in situ water content. For purposes of design criteria, it was assumed that for an in situ dredging production rate of 462 yd<sup>3</sup>/day (a 5 yd<sup>3</sup> bucket and a 12-hour day), approximately 42,500 gallons/day of excess water would be placed in the barges. Of this, 95 percent (40,400 gallons/ day) would be pumped off the barges and would require treatment. The decant water is expected to contain suspended and dissolved constituents. The water will be pumped out of the barges with submersible pumps mounted on a hydraulic excavator or HIAB crane system and stored in temporary onsite storage tanks until removed and transported offsite. The stored water will be transferred into trucks and/or rail for transport to a permitted wastewater treatment and discharge facility (i.e., Clean Harbors of CT, Inc. or Clean Harbors of Baltimore, Inc.).

### 6.2.2 Material Off-Loading

The dredged material from the removal area will be transferred to the sediment treatment facility with a long-reach excavator equipped with a 4.5 yd<sup>3</sup> hydraulic clamshell bucket. The off-loading facility will be equipped with a spill plate that will direct any potential spills between the barge and feed hopper back to the barge. The unloading rate for a 250 yd<sup>3</sup> barge, taking into account debris removal, the time required to remove excess water, and the time to resolve potential logistical issues, is anticipated to be approximately 1.8 hours (108 minutes). The parameters used to estimate the unloading rate are provided in **Table 6-1**.

TABLE 6-1

**Barge Unloading Rate Parameters**

*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Parameter	Value
Bucket size	4.5 yd <sup>3</sup>
Average fill capacity per bucket grab	80%
Average bucket cycle time	40 seconds
Average time to remove excess water	30 minutes
Average time to remove large debris	30 minutes
Average time to unload 250 yd <sup>3</sup> barge	33 minutes
Average time to shift barge	15 minutes

### 6.2.3 Material Separation

The offloaded sediment will be placed in a feed hopper where the material over 4 in. will be separated with a vibrating grizzly. The oversize material will be transferred to a segregated storage area/facility where it will be characterized for offsite disposal. The undersized material will be transferred via a conveyor belt to the pug mill system for stabilization. For the purposes of the design it assumed that the dredged sediment will contain 5 percent (by volume) material over 4 in. (See Section 8 for a discussion of TCLP values that show these sediments do not qualify as characteristic hazardous wastes.)

### 6.2.4 Stabilization

The screened material will be stabilized in a pug mill system with Portland cement. The sediment will be weighed

on the conveyor and approximately 10 percent (by weight) Type I/II Portland cement will be added to the material prior to its entering the pug mill. The percent of Portland cement added to the sediment will be adjusted as necessary in order to ensure the final cured sediment meets the paint filter test (USEPA Method 9095A) and yields a non-plastic material as defined by ASTM D4318. The mixing residence time will be sufficient to ensure that the materials are completely mixed prior to exiting the pug mill. The treated sediment will be transferred to the storage area/facility via a stacker conveyor system. The treated sediment will be held onsite for a minimum of 2 days to ensure that the material has properly cured prior to being loaded into trucks for offsite disposal.

### **6.2.5 Material Storage**

The debris, oversize material, and treated sediment will be stored onsite in a dedicated storage area or bin until characterized for offsite disposal. The storage areas will be sized to store between 2,000 to 3,000 yd<sup>3</sup> of stabilized sediment. Debris will be segregated from the sediment in a separate area or within roll-off containers. Once the disposal facility for each has been identified, it will be loaded into trucks for offsite transportation.

### **6.2.6 Water Treatment**

Water decanted from the barges prior to the stabilization process will be stored in tanks onsite and transported offsite for treatment at a commercial industrial wastewater facility. For purposes of design criteria, it was assumed that for an in situ dredging production rate of 462 yd<sup>3</sup>/day, approximately 95 percent of the excess water introduced into the barges (40,400 gallons/day) will be pumped out of the barges with submersible pumps mounted on a hydraulic excavator or HIAB crane system and stored in temporary onsite storage tanks. The barge water is expected to contain some suspended and dissolved constituents.

The water will be stored onsite until removed and transported offsite in trucks and/or rail for treatment and discharge at a permitted wastewater treatment facility (i.e., Clean Harbors of CT, Inc., or Clean Harbors of Baltimore, Inc.). Residuals from the onsite storage or treatment will be managed along with the RM 10.9 sediments. The details of the water treatment system will be provided in the Final Design Report once the transportation and disposal contractor has been selected.

## **6.3 Waterside Site Requirements**

Because the existing sediment stabilization facilities being considered are currently in operation, it is assumed that all required infrastructure and utilities are already in place. However, prior to receiving the dredge material the facility is required to receive an Acceptable Use Determination (AUD) from the NJDEP. Additional operational requirements for stabilization of the material may be required under the AUD.

## **6.4 Hours of Operation**

There are no restrictions for the stabilization operations, so it is assumed to be a 12-hours-per-day, 6-days-per-week operation. One day per week will be reserved for maintenance activities. However, the stabilization facility will be capable of receiving barges 24 hours per day.

## **6.5 Environmental Constraints**

Sediment stabilization will be undertaken in a manner that will minimize impacts on water quality, air quality, and noise. These operations will be conducted and monitored in accordance with applicable laws and regulations. All administrative and substantive aspects of the regulations will be complied with, and necessary permits will be obtained. These will be in accordance with the facilities' existing permits and monitored according to applicable statutory guidelines.

## **6.6 Sediment Stabilization Monitoring**

Text will be developed once a stabilization facility has been selected and an AUD has been provided by the NJDEP. At this time it is not anticipated that any additional operational monitoring will be required.

## 6.7 Operability, Reliability, and Maintainability

The operability, reliability, and maintainability of the sediment stabilization process will be sustained by using modularized equipment and have sufficient storage onsite to ensure that production is not halted by a mechanical failure during operations.

- Maintenance is assumed to require 1 day per week
- Average operational uptime of unloading facilities is typically 90 percent

## 6.8 Project and Community Health and Safety

The project specific and a community health and safety plan will include the sediment stabilization process and operations. The stabilization facilities are operating facilities and must have health and safety programs to address potential occupational health issues associated with the process. A project specific health and safety plan (**Appendix F**) has steps to review these facility plans. The stabilization facilities are operational and so potential impacts to the local community have been taken into account through the permitting process of the facilities. Any deviations that this project may cause will be included in the project specific Community Health and Safety Plan to make sure the community is informed of the work to be completed and the plans in place to protect the public during these activities. A Community Health and Safety Plan will be developed in conjunction with the appropriate government agencies and stakeholders. An outline of such a plan is provided in **Appendix G**.

## 7.1 Design Criteria

The main objective of the sediment cap is to protect human health and the environment. This will be achieved through the placement of a cap which includes both active and erosion protection (armor) layers to chemically isolate and sequester the transport of dissolved constituents from the underlying contaminated sediments into the water column.

To ensure the cap will be protective of future conditions, the current cap design accounts for variability in site conditions through the use of conservative (protective) values for the critical cap model input parameters (i.e., pore water concentrations and upwelling velocity). Further refinements to the cap design will be accomplished through supporting field studies to obtain site-specific values for these key input parameters and to evaluate mercury speciation below 2 ft (below the dredge depth). In the event that site-specific measurements of mercury speciation indicate the presence of high levels of methyl mercury, additional treatability studies may be needed to ensure that the current cap design is protective.

The refinement of cap model input parameters to site-specific values may reduce the required active layer thickness. Other aspects of the cap design will not be affected by the supporting field and potential treatability studies.

The cap system was designed to meet the following physical and chemical performance criteria:

- The armor layer will be physically stable under flow of 22,000 cfs, which is a 100-year return period flood flow
- The armor layer will prevent the active layer from being disturbed by ice
- The cap will be resistant to forces resulting from propeller scour
- The active layer will prevent the breakthrough of 2,3,7,8-TCDD, PCBs, and mercury for at least 1,000 years
- The active layer will prevent the breakthrough of the most mobile PAHs for at least 400 years

Key design criteria for the sediment cap are as follows:

- Design river flow is 22,000 cfs (i.e., estimated 100-year flow), as discussed in Section 3.5
- There is recreational boating, but no large commercial vessels
- Ice scour is assumed to have a minimal impact on the cap
- Cap is located adjacent to, not within, the federal navigation channel
- Design Darcy velocity (upwelling velocity) is 1,000 cm/yr, which will be further evaluated in the field in late 2012 or early 2013
- Design COPC pore water concentrations based on the lesser of either (1) sediment-pore water partitioning calculations using the maximum RM 10.9 Removal Area post-dredge sediment concentrations or solubility limits or (2) pore water concentrations from RM 10.9 sediment and/or pore water samples are to be collected and analyzed in late 2012/early 2013.

## 7.2 Cap Design

A cap will be placed over the post-dredge sediment surface to physically and chemically isolate the remaining sediment contaminants from the environment by means of physical containment, chemical containment, and erosion protection. The cap design incorporates several aspects of the physical environment including water body dimensions, depth and slope of the sediment bed, flow patterns, and potential disturbances such as ice scour. The cap design also takes into account expected effects of bioturbation, consolidation, and erosion to ensure its integrity over time.

The design of the chemical containment and protection from erosion and bioturbation are described in this section and follows guidance provided in the “Guidance for In Situ Subaqueous Capping of Contaminated Sediments” (Palermo et al., 1998), and “Contaminated Sediment Remediation Guidance for Hazardous Waste Sites” (USEPA, 2005). The general sequence of steps is as follows:

1. Establish cleanup objectives/performance criteria
2. Characterize the contaminated sediment (horizontally and vertically) including physical, chemical, and biological characteristics
3. Make a preliminary determination on the feasibility of in situ capping based on information obtained about the site and sediments
4. Identify potential sources of capping materials, including commercial sources for sand, gravel, and stone
5. Design the cap composition and thickness for both short and long-term chemical isolation of contaminants, bioturbation, consolidation, erosion, and other pertinent processes
6. Select appropriate equipment and placement techniques for the capping materials
7. Evaluate if the capping design meets the cleanup objectives/performance criteria
8. Develop an appropriate monitoring and management program to include construction monitoring during cap placement and long-term monitoring following cap placement
9. Develop cost estimates for the project to include construction, monitoring and maintenance costs

## 7.2.1 Chemical Containment

Preliminary chemical containment modeling using estimated coefficients indicates that a sand-only cap will not provide effective chemical containment at this site because of COPC concentrations remaining following dredging and groundwater upwelling through the sediments. Therefore, an active cap layer will need to be incorporated into the cap to chemically isolate the sediment contaminants from the environment. To effect this containment, the cap’s active layer will be one of the following: activated carbon, organoclay, or a mixture of both materials.

As part of the design, field activities will be conducted to measure pore water concentrations and groundwater flux. If necessary, a laboratory treatability study will be performed using site sediments and pore water to provide data for use in the chemical containment numerical model. The details of this field work and treatability study will be part of the Cap Design Field Work and Treatability Study QAPP Addendum (in progress) (**Appendix I**). The model results will be used to determine which materials (i.e., activated carbon and/or organoclay) and the quantity of materials that is required to best meet the cap performance criteria. The results of the performance modeling, and, if conducted, a treatability study, will be presented either in the Final Design or in an addendum to the Final Design.

### 7.2.1.1 Cap Performance Model

The numerical model CapSim (version 2.6, 2012), developed by Dr. Danny Reible of the University of Texas, will be used to predict the potential transport of select COPCs through the active cap. The CapSim model estimates pore water concentrations through and above the various cap layers, which are influenced by contaminant migration from the sediments below the cap (i.e., the sediments remaining after dredging). Four COPC groups, characterized by a representative chemical constituent, will be included in the CapSim modeling activities: dioxins/furans (2,3,7,8-TCDD), total PCBs (PCB-52), phenanthrene, and mercury. The representative chemical constituent for each COPC group was selected for its toxicity and/or mobility. For example, phenanthrene was selected to characterize PAH transport through the cap based on its lower molecular weight and moderate sorption capacity in sediments. These properties make phenanthrene more mobile compared to the heavier and stronger sorbing PAHs, thereby providing a more conservative modeling result.

The results from CapSim will facilitate both the design and the evaluation of long-term performance of the cap, which will incorporate a reactive layer above a sand layer. The reactive layer will consist of activated carbon, organoclay, or a combination of the two adsorbents. Other reactive layer designs such as mixing the adsorbents

with the sand layer will also be evaluated.

Due to the site-specific nature and complex chemistry of mercury, the performance of reactive materials, including activated carbon and organoclay, will be evaluated. Conservative estimates of mercury transport were modeled based on activated carbon partition coefficients provided by Dr. Upal Ghosh, of the University of Maryland, Baltimore, and several different mercury pore water concentrations: (1) total mercury at the solubility limit of mercury chloride, (2) total mercury at concentration levels typically measured at mercury-impacted sites (per Dr. Ghosh), and (3) methyl mercury at 10 percent of the total mercury concentration. The mercury concentrations used in the CapSim transport modeling will be compared against site-specific pore water measurements once those data are available. If site-specific mercury speciation results indicate levels of methyl mercury above the values evaluated by Dr. Ghosh (i.e., above the range used by Dr. Ghosh to produce the activated carbon partition coefficients he provided for use in the CapSim model), bench-scale treatability studies will be conducted. The CapSim numerical model will then be re-run based upon the treatability study results to ensure the cap's performance with regard to mercury transport.

### 7.2.1.2 Estimation of Pore Water Concentration

Pore water concentrations in the sediments underlying the cap are required as input to the CapSim model. Before site-specific pore water measurements are obtained, preliminary modeling will be performed using estimated pore water concentrations for 2,3,7,8-TCDD, PCB-52, and phenanthrene calculated using the equilibrium partitioning (EqP) method. However, preliminary modeling using literature-based partitioning coefficients can potentially overestimate dissolved COPC concentrations, and is therefore subject to the caveats described below. Since the EqP method is not applicable to mercury, conservative pore water concentrations will be used in the CapSim model. Once the site-specific pore water measurements are obtained, they will be used to rerun the CapSim model to obtain the required active layer thickness in order to finalize the cap design.

The calculations for estimating pore water concentrations using EqP method and the associated results are provided here. The EqP method assumes that equilibrium exists between COPCs sorbed to the bulk sediment and COPCs in the sediment pore water. This equilibrium is governed by the organic carbon–water partitioning coefficient ( $K_{oc}$ ).  $K_{oc}$  is a chemical-specific parameter, with higher values correlating to less mobile organic constituents and lower values correlating to more mobile organic constituents. Although estimates for this coefficient are routinely obtained from the literature when site-specific data are not available, values can vary from site to site due to the presence of multiple carbon phases. Near urban and/or industrial systems, sediments can contain anthropogenic or natural carbon phases which can result in the reduction of freely dissolved concentrations in pore water within the sediments. These additional carbon phases are not accounted for in the EqP method. Studies have shown that estimated pore water concentrations using the EqP method can overestimate freely dissolved aqueous concentrations by several orders of magnitude (Hawthorne et al., 2006, 2007; McDonough et al., 2010). However, for purposes of design, potential overestimates of pore water concentrations may not produce reasonable or acceptable cap thicknesses. In this case, actual pore water concentrations measured from site sediments will be used in the model simulations to support the final cap design.

For each COPC, the maximum sediment concentration measured within the RM 10.9 Removal Area (sediments from the depth interval 2.5 ft to native, representing the material remaining after dredging) was used as the input value for the bulk sediment concentration together with that sample's respective total organic carbon (TOC) concentration determined from laboratory analytical testing.

The pore water concentration ( $C_{pw}$ ) is predicted from the maximum measured bulk sediment concentration ( $C_{sed}$ ) and TOC as follows:

$$C_{pw} = C_{sed}/K_p$$

where  $K_p$  = sediment-water partition coefficient.

The  $K_p$  value is derived from the compound's organic carbon coefficient ( $K_{oc}$ ), which was obtained from USEPA (2012b) reported values. The  $K_p$  value is the  $K_{oc}$  adjusted by the fraction of organic carbon ( $f_{oc}$ ) in the sediment:

$$K_p = K_{oc} * f_{oc}$$

and

$$f_{oc} = \text{TOC}/100$$

The partition coefficient for PCB-52 was obtained from research conducted by Ghosh (2011). This work included laboratory partitioning studies to determine site-specific  $K_{oc}$  values for 42 PCB congeners using sediment samples collected from the LPR (RM 0.5 to 17.5). The  $K_{oc}$  value for PCB-52 and used in the EqP calculations ( $4.57\text{E}+06$ ) was at the lower end of the range of PCB congener specific values reported by Ghosh ( $3.5\text{E}+04$  to  $6.5\text{E}+11$ ). As discussed earlier, lower  $K_{oc}$  values represent more mobile constituents, and therefore, the selected PCB congener is representative of the more mobile PCB congeners estimated for the LPR, thus resulting in a more conservative (protective) input parameter for the modeling supporting the cap design. PCB-52 is also one of the most prevalent PCB congeners measured within the RM 10.9 Removal Area, and its adsorption to activated carbon and organoclay has been studied and presented in the scientific literature.

The estimated maximum pore water concentrations for 2,3,7,8-TCDD, PCB-52, and phenanthrene are presented in **Table 7-1**. These pore water values represent conservative (protective) concentrations that will be verified and updated based on results from the upcoming field studies discussed in the following section. It is anticipated that actual pore water concentrations will be significantly lower than the EqP method estimates presented in **Table 7-1**.

TABLE 7-1

**Estimated Maximum Pore Water Concentrations for Organic COPCs**

*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Chemical	$C_{sed}$ (mg/kg) <sup>a</sup>	$K_{oc}$ (L/kg) <sup>b</sup>	$f_{oc}$ <sup>a</sup>	$K_p$ (L/kg) <sup>c</sup>	$C_{pw}$ (µg/L) <sup>c</sup>
2,3,7,8-TCDD	0.030	$2.49\text{E}+05$	0.0813	$2.03\text{E}+04$	0.0015
PCB-52	28.4 <sup>d</sup>	$4.57\text{E}+06$	0.0934	$4.27\text{E}+05$	0.067
Phenanthrene	78.9	$2.29\text{E}+04$	0.0823	$1.89\text{E}+03$	41.8

$C_{sed}$ , sediment concentration;  $f_{oc}$ , fraction of organic carbon;  $K_p$ , sediment-water partition coefficient;  $C_{pw}$ , pore water concentration.

<sup>a</sup> Source: CH2M HILL and AECOM (2012).

<sup>b</sup> Sources: 2,3,7,8-TCDD, USEPA (2012b); PCB-52, Ghosh (2011); phenanthrene, USCHPPM (2006).

<sup>c</sup> Calculated value.

<sup>d</sup> Value represents total PCB concentration.

### 7.2.1.3 Supporting Field and Laboratory Activities

To provide site-specific input parameters for the chemical containment numerical modeling, field activities will be conducted to collect sediment cores for extraction of pore water and to install piezometers and/or seepage meters for measurement of groundwater flux through the sediments. The field work is anticipated to commence in mid-January 2013, allowing for sediment extraction and chemical analyses to be completed by mid-March 2013. Additional numerical modeling simulations will be subsequently performed through the end of March using the newly acquired site-specific parameters to finalize the active layer thickness.

Although not anticipated, if site-specific conditions indicate an unusually high level of methyl mercury, beyond which can be supported by the activated carbon partition coefficients provided by Dr. Upal Ghosh, supporting laboratory treatability studies will be initiated. These studies will require approximately 4 months to complete, with results anticipated to be available in June 2013, and subsequent numerical modeling and possible cap design modifications completed by early August 2013.

#### Sediment Cores for Pore Water Extraction

Pore water generated from site sediments will be analyzed for select COPCs and will be used in the laboratory treatability studies, if those studies are necessary. Sediment cores approximately 4 ft long will be collected from

within the removal area to obtain sediments representing the material remaining after dredging (i.e., from 2 ft to 4 ft below the mud line). Core locations will be targeted to generate pore water with the highest COPC concentrations. The cores will be sent intact to the laboratory for extraction of pore water via centrifugation and subsequent analysis of dioxin/furan congeners, PCB congeners, PAHs, and mercury speciation.

### **Laboratory Treatability Studies for Mercury**

Additional sediment cores will be collected to produce sufficient pore water volume in the event that mercury batch treatability studies are needed. These experiments will be conducted to evaluate the performance of activated carbon and organoclay for inorganic and organic mercury species. Kinetic experiments will be run to estimate the equilibrium time required for adsorption of mercury species onto activated carbon and organoclay and isotherm testing analyses will be conducted to obtain partition coefficients for mercury species onto these materials.

If sufficient pore water volume is not available to perform these experiments, site surface water will be used. In this case, site surface water will be spiked with stock solutions of mercury to achieve the concentrations required for the experiments.

### **Groundwater Seepage Velocity**

To estimate the velocity of groundwater seepage into the removal area, piezometers and/or seepage meters will be installed in areas of suspected groundwater discharge to the river. The piezometers will provide measurements of groundwater gradients and hydraulic conductivity to allow for the calculation of regional inflow rate to the river. The seepage meters will allow for localized measurement of seepage rates through the cap area for a given period of time, during which the net water accumulated (or lost) will be monitored to provide a direct measure of groundwater seepage into (or out of) the area to be dredged and capped.

## **7.2.2 Cap Armoring**

An armor layer is required to prevent erosion of the cap material during high river flows or because of other environmental forces. These erosive forces preclude the use of enhanced nature recovery via thin-layer capping. The armor layer design is based on a flow of 22,000 cfs which is the 100-year return period flood flow. Use of the 100-year return period flood for the design is consistent with recommendations in USEPA (2005) guidance and other cap designs (e.g., Hudson River); however, the cap is expected to remain generally intact even if the 100-year return period flow is exceeded. The river's velocities and associated erosive forces are not uniform, and the highest velocities used for design impact only small portions of the cap. Thus, the vast majority of the cap will withstand flows that are higher than the 100-year return period flood. At USEPA's request, the impact of designing for a more intense storm was also evaluated. The velocities and water depths associated with a 32,000 cfs, 500-year return period flood was utilized for that evaluation. The long-term monitoring of the cap will include event-based monitoring that will inspect the cap's physical integrity following large flow events such as the 25-, 50-, and 100-year return period flows.

Vessel traffic in the area of the site consists largely of recreational boating. It is assumed that the effects of propeller wash associated with maneuvering larger commercial vessels will not be an issue with this site and that breaking waves along the shoreline due to boat wakes will be negligible compared to erosive forces during flood flows.

The draft focused feasibility study (MPI, 2007) discusses ice scour as follows:

A limitation in colder regions is the potential erosion of a cap due to ice jam formations. According to the Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database, there have been three ice jam events recorded in the Passaic River at Chatham, New Jersey in the freshwater section of the river. Although ice forms in the Lower Passaic River, no records of ice jams were found in the Area of Focus. Therefore, cap erosion due to ice jams is not considered a major concern for the Area of Focus. Although ice scour at the shoreline could be an issue, it could be mitigated via biostabilization or installation of armoring materials at the shoreline.

Chatham is not near RM 10.9, as it is located above Little Falls in Paterson. Based on the lack of historical evidence of ice scour in the LPR and the substantial armoring that will be used to protect the cap from erosion during high

river flows, no additional provisions are included to protect the cap from ice scour.

### 7.2.2.1 Preliminary Armor Layer Sizing

Preliminary armor cap sizing was performed using methods presented in Palermo et al. (1998) based on water velocities and depths determined through three-dimensional (3D) hydraulic modeling of the 100-year return period flow and using the following equation to calculate the  $D_{50}$  armor stone size:

where:

$D_{50}$  = characteristic stone size of which 50 percent is finer by weight

$S_f$  = safety factor, minimum = 1.1

$C_s$  = stability coefficient for incipient failure (0.30 for angular rock, 0.35 for rounded rock)

$C_v$  = vertical velocity distribution coefficient

$C_T$  = thickness coefficient = 1.0 if thickness =  $D_{100}(\text{max})$  or  $1.5D_{50}(\text{max})$

$C_G$  = gradation coefficient =  $(D_{85}/D_{15})^{1/3}$

$D_{85}/D_{15}$  = gradation uniformity coefficient (typical range = 1.8 to 3.5)

$d$  = local water depth

$\tilde{a}_w$  = unit weight of water (assumed 62.4 lb/ft<sup>3</sup>)

$\tilde{a}_s$  = unit weight of stone (assumed 165 lb/ft<sup>3</sup>)

$V$  = local depth averaged velocity

$K_1$  = side slope correction factor (assume 1.0 for flat bottom)

$g$  = gravitational constant

Results from the 3D hydraulic modeling were used to determine depth averaged velocities and local water depths over the area of the site for the design flow. These are shown in **Figures 3-4** and **3-5**, respectively. Armor size was calculated for combinations of water depth and velocity for each model cell within the footprint of the removal area downstream of Station 31+00.

It was assumed that the armor layer consists of angular rock ( $C_s = 0.3$ ) with a gradation such that  $D_{85}/D_{15} = 2.5$ . Rounded rock and a more well-graded layer would result in greater stone size requirements and therefore, depending on the source of stone used, recalculation of rock size may be necessary. The vertical velocity coefficient,  $C_v$ , was assumed to be 1.0, as recommended for locations on the insides of bends, and the thickness coefficient ( $C_T$ ) was set to 1.0.

The side slope correction factor,  $K_1$ , can be calculated as:

where:

$K_1$  = side slope correction factor

$\theta$  = bottom slope angle

$\phi$  = angle of repose (assumed 40 degrees)

Initial calculations assumed a  $K_1$  value of 1.0 consistent with a flat bottom. Review of cross sections through the proposed cap downstream of Station 31+00 showed slopes of the cap resulting of  $K_1$  values of 0.93 and greater

and had no impact on calculation of recommended armor sizes in this area.

**Table 7-2** summarizes results of armor size calculations for the 100-year return period flow and presents the maximum calculated required armor size for the areas within the removal area downstream of Station 31+00 defined by the given bottom elevation ranges. Based on these results, it is recommended that an armor layer with a  $D_{50}$  of 4.5 in. (Armor Stone Type A) be specified in areas deeper than the -3.0 ft bottom surface contour and an armor layer with a  $D_{50}$  of 2 in. (Armor Stone Type B) be specified in areas shallower than the -3.0 ft contour.

TABLE 7-2

**Maximum Calculated Median Armor Stone Size vs.  
Bottom Elevation**

*RM 10.9 Pre-Final Design Report, Lower Passaic River  
Study Area, New Jersey*

Bottom Elevation (ft)	Maximum Calculated $D_{50}$ (in.)
< -6.0	6.6
-6.0 to -5.0	5.9
-5.0 to -4.0	5.4
-4.0 to -3.0	4.9
-3.0 to -2.0	3.9
-2.0 to -1.0	2.9
-1.0 to 0	2.0

Palermo et al. (1998) recommended an armor layer thickness as the maximum of  $1.0D_{100}(\text{max})$  or  $1.5D_{50}$ . It is also recommended that the layer thickness be increased by 50 percent for underwater placement. Based on these recommendations, the minimum thicknesses of Armor Stone Types A and B are calculated to be 10 in. and 4.5 in., respectively. In order to provide a more conservative cap design and to assure that the minimum cap thicknesses are achieved during cap material placement, the average cap thickness for both types of armor stone will be specified to be 12 inches.

If a 500-year return period storm were to be used to design the cap, the minimum  $D_{50}$  for Armor Stone Types A and B would be 7 in. and 4 in., respectively. The calculated minimum thicknesses of the Armor Stone Types A and B layers would be 16 in. and 9 in., respectively. The corresponding average cap thicknesses would be specified as 18 in. and 12 in., respectively.

### 7.2.3 Physical Separation and Stabilization Layers

A sand layer 6 in. thick will physically separate the sediment and the active layer, which will reduce the physical fouling of the active layer by the underlying sediments. A geotextile will be placed between the active layer and the armor layer. The function of the geotextile is to protect the active layer during placement of the armor layer and prevent the active material from being eroded or gouged through the protective stone layer. The geotextile, in addition to the armor stone layer, acts as a bioturbation barrier—preventing burrowing benthic organisms from passing into the active layer and the contaminated sediment.

A Reactive Core Mat incorporates active organoclay amendment material within two layers of geotextile. The Reactive Core Mat's two layers of geotextile serve the same purpose as the 6 in. thick sand layer and geotextile described above. Thus, if a Reactive Core Mat is utilized as the active layer instead of bulk materials, the sand layer and separate geotextile will be eliminated from the cap design as they would be redundant.

### 7.2.4 Design Cap Plan and Sections

The cap plan is shown in **Figure 7-1**. The area to be capped extends only to 31+00. Upstream of this point, from

Station 31+00 to 37+50, the sediment surface slopes at greater than 3:1 (see **Figure 4-1**), which is too steep to effectively cap. As a result, the soft sediment in this area will be removed rather than be dredged for 2 ft and capped. Typical example design cap sections, which vary based on the post-dredge water depth, are shown in **Figure 7-2**. The nominal thickness of the cap section with Armor Stone Types A and B is 12 in, plus the active layer thickness. The active layer is expected to be 4 to 6 in. thick. Final cap elements, materials, and thicknesses will be confirmed following the planned cap performance testing.

### 7.2.5 Post-capping Habitat

Placement of the cap will consolidate the underlying soft sediments, as the cap weighs more than the sediment removed during dredging. The amount and rate of consolidation is dependent on the sediment characteristics and thickness and the weight of the cap versus the sediment removed. Based on experience at other alluvial sandy capping locations, several inches of consolidation are anticipated, with most of the consolidation typically beginning immediately after cap placement and occurring in the first year. The thicker Armor Stone Type A cap section will be placed in deeper water (below -3.0 ft contour) and will be submerged. The thinner Armor Stone Type B cap section will be placed in shallower water (above -3.0 ft contour). The top of the thinner Armor Stone Type B cap section will be at a lower elevation than the current sediment surface even prior to sediment consolidation.

Following cap placement, natural sedimentation will begin to fill in the spaces between the armor stone and eventually cover the stone as the area is generally depositional. The deposited sediment will create a habitat similar to the current sediment habitat which is a mudflat with no submerged aquatic vegetation. The shape of the armor stone (i.e., angular versus rounded) is not expected to impact the new habitat because the stone will be buried by the soft sediment. Thus, there is no advantage to the habitat in using rounded stone for the armor layer. As noted in Section 7.2.3, the armor and geotextile will create a barrier to bioturbation into the contaminated sediment and active layer as they will prevent benthic organisms from burrowing below the reestablished soft sediment layer.

## 7.3 Active Cap Sorbent Materials

The cap's active layer will be either activated carbon or organoclay or a mixture of both materials. The active layer can be placed as a Reactive Core Mat(s) as manufactured by CETCO, AquaGate composite particles manufactured by AquaBlok, SediMite (pellet form of activated carbon) or, possibly, as bulk material mixed within a sand layer.

The design sand gradation is shown in **Table 7-3**. This sand material meets a more restrictive standard than the American Society of Testing Materials (ASTM) C33 gradation for fine aggregates because it reduces the #200 sieve from 0–3 percent to 0–1 percent passing. The reasons for this material selection are as follows:

1. It is readily available as concrete sand (i.e., sand for making concrete) that has been additionally washed to reduce the fine content
2. Its coarse nature allows it to be readily cast by either broadcast spreading equipment or clamshell
3. Less fines content minimizes material loss and associated turbidity during placement activities

The geotextile material between the active layer and armor stone will be a nonwoven 100 percent plastic high-strength dimensionally stable filter fabric. It will be

TABLE 7-3  
**Sand Gradation (Modified ASTM C33 Fine Aggregate)**  
*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Sieve Size	% Passing
3/8 in.	100
#4	95–100
#8	80–100
#16	50–85
#30	25–60
#50	10–30
#100	2–10
#200 <sup>a</sup>	0–11

<sup>a</sup>Specification for passing #200 sieve reduced from 0 to 3 percent for ASTM C33 Fine Aggregate.

designed so that the average opening size, permeability, permittivity, UV resistance, thickness, strength, and elongation properties meet appropriate ASTM criteria according to the site conditions and materials. Engineering properties of geotextile are presented in **Table 7-4**.

TABLE 7-4

**Geotextile Properties and Applicable Standards***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Property <sup>a</sup>	Test Method	Units	MARV <sup>b</sup>
Grab strength	ASTM D 4632	N	1400
Sewn seam strength <sup>c</sup>	ASTM D 4632	N	1260
Trapezoidal tear strength	ASTM D 4533	N	500
Puncture strength	ASTM D 6241	N	2750
Permittivity	ASTM D 4491	sec <sup>-1</sup>	0.5 <sup>d</sup>
AOS	ASTM D 4751	mm	0.5 <sup>d,e</sup>
UV stability (retained strength)	ASTM D 4355	percent	50 (after 500 hours)

AOS, apparent opening size; UV, ultraviolet; N, newton; mm, millimeter; sec, second.

<sup>a</sup> AASHTO Standard Specification M 288, Type 1 geotextile for erosion control, separation, and survivability.

<sup>b</sup> Minimum average roll value in weaker principal direction, except as noted otherwise.

<sup>c</sup> If sewn seams required; otherwise overlap.

<sup>d</sup> AOS and permittivity are perpendicular to plane of geotextile.

<sup>e</sup> AOS is maximum size allowed.

The armor stone layer for water depths less than -3 ft will have a  $D_{50}$  of 4.5 in. The armor stone layer for water depths greater than -3 ft will have a  $D_{50}$  of 2 in.

The quantities of cap materials, which were estimated using plan projection and average end area methods, are summarized in **Table 7-5**. The volume of cap materials to be placed is calculated to be 15,900 yd<sup>3</sup>, which is less than the approximately 18,000 yd<sup>3</sup> of sediment to be removed. Therefore, the net impact of the RM 10.9 Removal Action will be to reduce the volume of materials in the LPR (i.e., no net fill), while maintaining the approximate existing sediment surface profile. No net fill is a requirement of the Flood Hazard Area Control Rules (N.J.A.C. 7:13), which are intended to prevent actions that would exacerbate flooding in flood hazard areas. Placement of the cap materials will also consolidate the underlying sediments, thereby further reducing the apparent volume of the capping materials.

## 7.4 Cap Materials and Transport

The active layers will come from specialty companies and with certifications of the material composition. Sand cap and armor material will come from local/regional vendors of this type of material. The selection of the vendor will include an evaluation of the vendor's operations to ensure the material is free of contaminants. This evaluation will part of the Construction Quality Control Plan (**Appendix J**). The cap materials may come to the capping contractor's staging area via truck or barge and will be delivered to the capping site by barges.

TABLE 7-5

**Material Quantities**

*RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Material	Units	Quantities
4 in. thick active layer	ft <sup>2</sup>	217,000
	yd <sup>3</sup>	2,700
6 in. thick sand layer	yd <sup>3</sup>	4,000
Geotextile	ft <sup>2</sup>	230,000
Type A armor stone	yd <sup>3</sup>	7,200
	Tons <sup>a</sup>	10,800
Type B armor stone	yd <sup>3</sup>	1,600
	Tons <sup>a</sup>	2,400

<sup>a</sup>Tons estimated at rate of 1.5 tons per cubic yard.

## 7.5 Cap Placement Equipment

The cap placement activities are assumed to occur from equipment located on barges with material supplied by material barges; however, determination of the actual equipment to be used will be the responsibility of the selected cap placement contractor.

The Reactive Core Mat is supplied as rolls on tubes. The tube holding the mat is picked up and held by a crane as the mat is unrolled onto the submerged sediment surface. Diver assistance, seaming, and pinning the mats in-place are typically necessary. Recent Reactive Core Mat developments also include deployment in large accordion-like panels directly from a barge. If AquaGate or SediMite material is used instead of a Reactive Core Mat, the material will be placed in the same manner as the sand is placed—from a barge by either a broadcast spreader or a clamshell bucket. Sand will be placed in a manner to minimize disturbing the sediment and to provide a distinct sand/sediment interface rather than intermixing the sand and sediment. Placement of the sand as the initial layer of the cap will minimize disturbance of the sediment during placement of the subsequent cap layers.

The geotextile between the active layer and the armor stone will be unrolled onto the active layer surface by a crane on a barge.

Armor stone will be placed by a clamshell bucket from a barge.

## 7.6 Cap Placement Criteria

### 7.6.1 Placement Thickness Criteria

The minimum and average thicknesses of the sand layer are 4 in. and 6 in., respectively. The minimum and average thicknesses of the active layer are 3 in. and 4 in., respectively. The minimum thicknesses of Armor Stone Types A and B are 10 in. and 4.5 in., respectively. The average cap thickness for both types of armor stone is 12 inches.

### 7.6.2 Placement Accuracy and Tolerance

Specifications for placement accuracy and tolerances of the cap's sand, active, and armor layers are based on the cap design for the Lower Fox River Operable Unit 1 (CH2M HILL et al., 2008). The placement accuracy for and tolerance specifications of the sand and armor layers will have been satisfied when the following statistical criterion is demonstrated:

- The probability of applied design thickness being met in less than 80 percent of the capped area is no more than 10 percent.

The applied thickness of the sand and active layers will be monitored during and post-construction via push cores. The armor layer will be monitored during and after construction using gauge sticks and/or buckets. These physical measuring devices will be placed on the surface of the underlying layer prior to application of the material in the layer being constructed.

An example of how the statistical criterion is applied is provided in Appendix B.

### **7.6.3 Placement Rate**

Placement of sand on the Hudson River with clamshell buckets of 1 to 3 yd<sup>3</sup> averaged approximately 40 yd<sup>3</sup>/hr (Louis Berger Group, 2010). Although broadcast spreaders have achieved a sand placement rate on the order of 70 yd<sup>3</sup>/hr, a placement rate of 40 yd<sup>3</sup>/hr is expected for the RM 10.9 Removal Area because of the relatively small scale of the project, the impact of the tidal cycle on operations, and expected use of a clamshell bucket for placement. The placement of SediMite may be by either broadcast spreader or clamshell bucket, with placement rate expected to be similar to that of sand. The placement rate of a Reactive Core Mat is expected to be on the order of 100 m<sup>2</sup>/hr based on the Anacostia River installation experience (Lowery et al., 2009), but could vary based on the final cap configuration, nature of the active capping element(s), and conditions encountered at the time of the work. The armor stone placement rate is expected to be 40 yd<sup>3</sup>/hr for a 3 yd<sup>3</sup> bucket.

### **7.6.4 Placement Sequence**

The cap will be placed following completion of the dredging to control residuals generated during dredging and minimizing the risk of contaminating the clean cap material. The sediment that is uncovered during dredging does not have significantly different concentrations of COPCs than the existing surficial sediment; thus, there is no additional risk to the environment from the newly exposed sediment. The physical constraints of the site make it difficult to have both dredging equipment with material barges and capping equipment with material barges operating at the same time. The cap will be placed as soon as practical after the dredging operations have been completed.

### **7.6.5 Hours of Operation**

Placement of cap materials will be limited to 12 hours per day or during daylight hours only, whichever is less. The number of days per week of placement operations will not be mandated, but they are expected to be either 6 or 7.

### **7.6.6 Operability, Reliability, and Maintainability**

Operational uptime for the capping activities is typically expected to be in the range of 70–80 percent. However, the relatively small area to be capped may result in a lower effective uptime because mobilization and other essential, but nonproductive, activities take a greater proportion of time on smaller projects such as this one than on larger projects.

## **7.7 Waterside Site Requirements**

The capping contractor will be required to provide their own waterside site(s) as necessary to implement the capping activities, including land with marine access for staging/temporarily stockpiling and loading and transporting cap materials and capping equipment. However, an area may be available adjacent to the site for construction support trailers.

## **7.8 Environmental Constraints**

The environmental impacts from the cap placement activities will be mitigated by the design requiring that control procedures be incorporated into the cap placement activities.

### **7.8.1 Water Quality**

Turbidity management for capping activities will consist of removing most of the turbidity-causing fines from the capping materials before they are placed in the LPR. This approach has been effectively used on other capping projects (Foth et. al., 2009) and is much more effective than attempting to control the fines after they occur as

turbidity in the LPR. The fines are minimized in the sand capping materials by specifying a low fine content, which can be achieved by additional washing of the sand by the sand supplier.

The cap placement operation is not expected to generate significant turbidity or promote further disturbance of the post-dredge sediment surface. The sand layer will be carefully placed over the post-dredge surface to minimize disturbing and resuspending the sediment. Once the sand layer has been placed, no significant sediment resuspension will occur. Turbidity generated by sand placement will be minimized by reducing the fines in the sand cap material. No fines are associated with a Reactive Core Mat. No significant fines are associated with the either the SediMite or AquaGate material, so if either are used for the active layer, no appreciable turbidity would be generated by their placement. No turbidity-generating fines are associated with the geotextile material that is placed above the active layer. The cap armor stone will be relatively free of fines and, therefore, will not generate an appreciable amount of turbidity during placement. No other water quality impacts related to the cap placement operation, except those associated with equipment movement, are anticipated.

The water quality monitoring requirements established for the dredging operations will also be followed during the capping activities. As with dredging, BMPs and control measures will be used during cap placement to further minimize any increased turbidity.

### 7.8.2 Air Quality

Dust generation from the capping activities is not expected because the capping materials (e.g., extra-washed sand) will not contain appreciable amounts of fine particles, and the cap itself will be placed on the sediment beneath the water surface.

No odors are expected from the capping activities because none of the capping materials (i.e., sand, stone, geotextile, and Reactive Core Mat or AquaGate) have odors associated with them. Cap placement will occur below the water surface after dredging has occurred. The Reactive Core Mat or AquaGate material will be placed over the sediment surface while minimizing disturbance to the underlying sediment and, therefore, any potential release of odors from the sediment. The Reactive Core Mat or AquaGate material will then shield the sediment from being disturbed during sand placement.

### 7.8.3 Noise

All capping activities will be completed in such a manner that the noise levels do not exceed the maximum noise contribution limits established for the project. Placing stone for the cap's armor layer will unavoidably generate noise as this material is loaded and unloaded into and from the material supply barges and by handling with the cap placement equipment. The noise generated by the cap placement operations will be restricted to the placement operation hours (i.e., daylight hours or 12 hours per day, whichever is less) and will be compliant with the noise requirements described in Section 2. As described in **Table 2-2**, NJAC 7:29 is considered relevant and appropriate, although this type of activity does not fit the definition of a regulated activity under that rule. The capping will be conducted to target achieving the noise limitations stated therein. The noise-monitoring program established for dredging operations will also be utilized for the capping activities see **Table 4-5**.

## 7.9 Project and Community Health and Safety

A project specific and a community health and safety plan will be developed to include the capping and in-river capping material transport operations. A number of potential occupational health issues are associated with the proposed dredging operations that are addressed in the Project Health and Safety Plan (**Appendix F**). The capping and material transport operations have the potential to impact the local community surrounding the capping operations and possible up and down the river. It is very important that the community is informed of the work to be completed and the plans in place to protect the public during these activities. A Community Health and Safety Plan will be developed in junction with the necessary agencies and public groups. And outline of such a plan is provided in **Appendix G**.

## 7.10 Long-Term Cap Monitoring and Maintenance Plan

A plan for long-term post-construction cap monitoring and maintenance and the associated QAPP Addendum has

been prepared and included in **Appendix K**. The objective of the monitoring will be to identify and evaluate changes in the physical or chemical properties of the cap that would significantly reduce its protectiveness.

# Overland Transportation and Offsite Disposal

## 8.1 Design Criteria

A transportation and disposal contractor will be acquired by means of a request for proposal and evaluated using a cost/technical trade-off approach. The contractor will be selected based on corporate experience, experience of key personnel, technical and managerial capabilities, record of past performance, and cost.

The sediment will be transported to a permitted waterside facility where it will undergo stabilization prior to transport to an out-of-state Subtitle C landfill, as described in Section 6.

## 8.2 Regulatory Guidelines

Prior sample results indicate that the sediment is not RCRA hazardous and that PCB concentrations are below the TSCA regulatory threshold of 50 ppm. However, the RM 10.9 Removal Action is a CERCLA action involving the offsite transfer of any hazardous substance, pollutant, or contaminant (CERCLA wastes). Therefore, the Off-Site Rule (OSR) (40 CFR 300.440) is applicable. The OSR requires CERCLA wastes to be placed only in a facility operating in compliance with RCRA or other applicable federal or state requirements. Sediment profiles will be submitted to commercial offsite sediment management facilities for their acceptance. Such facilities will be appropriately permitted, will have positive compliance records, and will be approved by the USEPA OSR coordinator for OSR compliance. A New Jersey AUD will be obtained for management of the dredge material, including its acceptance at either the Jay Cashman dredged material processing facility in Elizabeth, NJ (which is on Arthur Kill and within the Newark Bay Study Area) or at the Clean Earth/Koppers processing facility on the Hackensack River, which is outside of the Passaic River Superfund Study Area and the Newark Bay Study Area).

Several ARARs listed in Section 2 are applicable to management of the sediment removed for this project. These include the Clean Water Act, Rivers and Harbors Act, and New Jersey Waterfront Development Act, which encompasses Coastal Zone Management. All potential treatment options being considered in this design would be implemented at an existing commercial offsite upland facility with eventual disposal at an out-of-state existing commercial landfill. All applicable regulations, both substantive and administrative, will be complied with during the offsite management of the sediment; however, those requirements are not considered ARARs because they do not apply to onsite activities and therefore are not fully identified in this Removal Action design. The final design will address the offsite regulatory requirements.

A hazardous waste is either a “listed” waste or a “characteristic” waste based on RCRA designation criteria. Contaminated environmental media are not hazardous waste but can become subject to regulation under RCRA if they “contain” hazardous waste. USEPA generally considers contaminated environmental media to contain hazardous waste (1) when they exhibit a characteristic of hazardous waste or (2) when they are contaminated with concentrations of hazardous constituents from listed hazardous waste that are above health-based levels.

In 2008, Region 2 prepared a memo to the file for the LPRSA that discussed their consideration of the Passaic River sediments pursuant to RCRA 40 CFR Section 261.31. Region 2 reviewed historical information and consulted USEPA Headquarters Office of Solid Waste, and concluded that it did not have sufficient evidence to conclude that the sediments in the Passaic River contain “listed” hazardous waste per 40 CFR 261. However, if the sediment exhibits a characteristic of hazardous waste, it must be managed as though it were a hazardous waste. Dredged material that is subject to the requirements of a permit that has been issued under 404 of the Federal Water Pollution Control Act (33 U.S.C.1344) or section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1413) is not a hazardous waste. The New Jersey Water Quality Certification and AUD may address the transportation and disposal of this dredged material. If not specified in those mechanisms, the decision tree for RM 10.9 sediment disposal is listed below:

- If required by the landfill, the sediment will be disposed of as if it were “characteristic” hazardous waste if sample results analyzed per Toxicity Characteristic Leaching Procedure (TCLP – SW-846 Method 1311) for

regulated constituents exceed the regulatory screening levels and if such samples are deemed to be representative of the sediment waste stream.

- If TCLP sample results exceed screening levels for one or more constituents, then the material may be considered a RCRA hazardous waste by the disposal facility, and therefore would likely be able to achieve the applicable standards evaluated per the Land Disposal Restrictions (LDR) found at 40 CFR 268.
  - If the results for one or more underlying hazardous constituents exceed 10 times the Universal Treatment Standards (UTS), then the disposal facility may require that the sediment be treated before it can be disposed of in a landfill. Since the sediment being removed from the RM 10.9 Removal Area contains dioxins, the only treatment available per the LDR is incineration.
- The sediment will be evaluated to determine if it passes the paint filter test, which is a requirement for both Subtitle D and Subtitle C landfill disposal. If it does not, it will be treated or rendered so that it does pass the paint filter test.
- If TCLP sample results do not exceed RCRA screening levels, then the sediment may be disposed of in a RCRA Subtitle D or C landfill. Subtitle D landfill disposal will depend on the individual permit and state requirements for a particular Subtitle D landfill.

An initial screening was completed on the available removal area data. Samples submitted for TCLP analysis included two investigation-derived waste (IDW) characterization samples generated during the 2011 RM 10.9 Characterization Program and two composite samples collected during the bulk sediment and delineation sampling event in May 2012 (RM 10.9 QAPP Addendum A). None of the tested TCLP parameters exceed applicable RCRA threshold criteria for designation as hazardous waste. Additional details are provided below.

Five bulk sediment sampling stations for the bench-scale testing of sediment treatment technologies and dewatering technologies were chosen based on review of the RM 10.9 analytical results. PCDDs/PCDFs as represented by 2, 3, 7, 8 TCDD, total PCBs, mercury, and PAHs were selected as having relatively elevated concentrations of these COPCs, in comparison to the other sediments in the RM 10.9 Removal Area.

Sampling depth was selected by reviewing how the average concentrations of the COPCs vary with depth for all stations located within the RM 10.9 Removal Area. Five stations were selected for sediment collection. Sampling locations within the RM 10.9 Removal Area were selected to correspond to the locations with the highest values of the COPCs encountered in the sediment to 3.5 ft in depth during the 2011 RM 10.9 Characterization Program. To select these locations, an average concentration for each of the four COPCs was calculated for each of the 25 locations in the removal area. At each core location, the average concentrations of the four sample intervals from 0 to 3.5 ft were calculated. Each location and COPC was then ranked from 1 as the highest average concentration to 25 the lowest average concentration. The rankings for all the COPCs were then summed for each location. These summed rankings were then ranked to select the five locations with the highest average COPC concentrations.

In order to collect sufficient volume for these studies from the five stations, cores were collected as follows: each core will be 48 in. long and 4 in. in diameter, yielding a usable core 3.5 in. in diameter. The resulting volume of sediment per core was approximately 2 gallons. At each of five stations, six cores were collected for each bench-scale vendor for a total of 12 cores at the location.

Samples of the bulk sediment were submitted for analysis for chemical and physical parameters. In addition to other analysis this analysis included TCLP, volatile organic compounds (VOCs), TCLP semivolatile organic compounds (SVOCs), TCLP organochlorine pesticides, TCLP chlorinated herbicides, TCLP metals, TCLP mercury, flashpoint, oil and grease (n-hexane extractable material [HEM] and silica gel treated n-hexane extractable material [SGT-HEM; Non-Polar Material] by extraction and gravimetry), total cyanide, sulfide, pH, corrosivity, paint filter, and percent solids.

Results of the TCLP analysis for the two composite samples are provided in **Table 8-1**. None of the TCLP parameters exceed the RCRA Regulatory Value.

TABLE 8-1

**RM 10.9 Composite Samples Waste Characterization Profile***RM 10.9 Pre-Final Design Report, Lower Passaic River Study Area, New Jersey*

Analyte	Units	RM 10.9 Composite Samples				Average Detected		RCRA Regulatory Value	RCRA Code	UTS Screening Value
		COMP-V01AS		COMP-V02BS						
Herbicides—TCLP										
2,4,5-TP (Silvex)	µg/L	5.0E-01	U	5.0E-01	U	ND		1,000	D017	—
2,4-D	µg/L	2.0	U	2.0	U	ND		10,000	D016	—
Metals—TCLP										
Arsenic	mg/L	0.083	J	0.096	J	0.090	J	5	D004	5
Barium	mg/L	0.43	JB	0.42	JB	0.43	JB	100	D005	21
Cadmium	mg/L	0.11		0.12		0.12		1	D006	0.11
Chromium	mg/L	0.016	J	0.017	J	0.017	J	5	D007	0.6
Lead	mg/L	0.20	J	0.19	J	0.20	J	5	D008	0.75
Mercury	mg/L	0.0020	U	0.0020	U	ND		0.2	D009	0.025
Selenium	mg/L	0.0048	J	0.0071	J	0.0060	J	1	D010	5.7
Silver	mg/L	0.50	U	0.50	U	ND		5	D011	0.14
Pesticides—TCLP										
Chlordane	µg/L	12	U	12	U	ND		30	D020	—
Endrin	µg/L	1.2	U	1.2	U	ND		20	D012	—
Gamma-BHC(Lindane)	µg/L	1.2	U	1.2	U	ND		400	D013	—
Heptachlor	µg/L	1.2	U	1.2	U	ND		8	D031	—
Heptachlorepoide	µg/L	1.2	U	1.2	U	ND		8	D031	—
Methoxychlor	µg/L	2.4	U	2.4	U	ND		10,000	D014	—
Toxaphene	µg/L	48	U	48	U	ND		500	D015	—
SVOCs—TCLP										
2,4,5-Trichlorophenol	µg/L	20.0	U	20.0	U	ND		400,000	D041	—
2,4,6-Trichlorophenol	µg/L	20.0	U	20.0	U	ND		2,000	D042	—
2,4-Dinitrotoluene	µg/L	20.0	U	20.0	U	ND		130	D030	—
2-Methylphenol	µg/L	1.3	J	4.0	U	1.3	J	200,000	D023	—
4-Methylphenol	µg/L	16	J	8.4	J	12.2	J	200,000	D025	—
Hexachlorobenzene	µg/L	20.0	U	20.0	U	ND		130	D032	—
Hexachlorobutadiene	µg/L	20.0	U	20.0	U	ND		500	D033	—
Hexachloroethane	µg/L	20.0	U	20.0	U	ND		3,000	D034	—
Nitrobenzene	µg/L	4.0	U	4.0	U	ND		2,000	D036	—
Pentachlorophenol	µg/L	40.0	U	40.0	U	ND		100,000	D037	—
Pyridine	µg/L	20.0	U	20.0	U	ND		5,000	D038	—

Total Cresol	µg/L	—		—		—	200,000	D026	—
<b>VOCs—TCLP</b>									
1,1-Dichloroethene	µg/L	25.0	U	25.0	U	ND	700	D029	—
1,2-Dichloroethane	µg/L	25.0	U	25.0	U	ND	500	D028	—
1,4-Dichlorobenzene	µg/L	4.0	U	4.0	U	ND	7,500	D027	—
2-Butanone	µg/L	250	U	250	U	ND	200,000	D035	—
Benzene	µg/L	25	U	25	U	ND	500	D018	—
Carbontetrachloride	µg/L	25	U	25	U	ND	500	D019	—
Chlorobenzene	µg/L	25	U	25	U	ND	100,000	D021	—
Chloroform	µg/L	25	U	25	U	ND	6,000	D022	—
Tetrachloroethene	µg/L	25	U	25	U	ND	700	D039	—
Trichloroethene	µg/L	25	U	25	U	ND	500	D040	—
Vinyl Chloride	µg/L	25	U	25	U	ND	200	D043	—

The sample locations comprising the composite sample were chosen based on having higher concentrations of dioxin, PCBs, mercury, and PAHS. The TCLP results from these four samples were compared to RCRA screening levels, and non-TCLP analytical results from 25 cores within the removal area for the 0–2.5 ft sampling intervals were compiled to provide an initial composite chemical concentration profile. Results were as follows:

- The four TCLP analytical results did not exceed RCRA screening levels for any regulated constituent.

These screening results indicate that the sediment to be removed would not be designated as hazardous under RCRA. However, the sediment may require disposal at a RCRA Subtitle C landfill due to regulations concerning concentrations of dioxin.

The OSR also requires that USEPA approves the final disposition facility.

Sediment profiling for disposal and disposal options will be performed before the Final Design. Initial discussions with the out-of-state subtitle C landfills indicate that additional samples need to be collected for TCLP analysis. The details of this field work and analysis will be in a QAPP Addendum that is currently being prepared.

## 8.3 Transportation Options

The options for transporting stabilized sediment for offsite landfill disposal are dependent on which stabilization contractor is selected and which landfill is selected for disposal. Transportation of the sediment to the disposal facility will be the responsibility of the disposal facility since much is determined by the location of the disposal facility. The means of transportation may be truck, truck and rail or just rail. The Clean Earth Koppers facility in Kearny, NJ does have on-site access to rail where as the stabilization facility in Elizabeth, NJ Cashman Dredging and Marine does not. Due to the complicated rail system it is quite possible that the mode will be truck to rail where trucks transport the processed sediment in lined intermodal containers to a rail loading facility for shipment to the landfill by rail. Once the stabilization and disposal contractors are selected the details of the transportation process will be completed.

## 8.4 Disposal Options

The final option for disposal will be dependent on the designation of the waste material based on characteristics of the end product(s) from the treatment process. The final treated material and its associated byproducts will be profiled for disposal in a Subtitle C landfill. The potential waste streams to be profiled include the following:

- Stabilized sediment
- Debris
- Material larger than 4 in.
- Excess barge water removed prior to unloading

Each of these waste streams could potentially be disposed of at a separate facility; the disposal options for each will be refined before the Final Design.

The Subtitle C landfills currently being considered for the stabilized sediment include the following:

- Heritage Environmental Services, Roachdale, Indiana
- Lone Mountain (Waynoka), Oklahoma Facility (Clean Harbors, Inc.)
- Wayne Disposal, Inc. (WDI), Belleville, Michigan (EQ Northeast, Inc.)
- Chemical Waste Management, Emelle, Alabama, and Model City, New York

The following selection criteria will be utilized to determine the most cost-effective disposal option:

- RCRA designation and characterization of waste materials
- Weight of treated material as well the associated by product materials generated (e.g., debris, material over 4 in., sand) in the stabilization process
- Method of transportation (rail or truck)
- Distance from site to disposal facility

## 8.5 Road Network and Existing Traffic Volumes

If all of the processed sediment is transported by truck to the selected landfill, approximately 20–30 trucks per day over a time period or approximately several weeks would be required. This amount of truck traffic, which would operate on local roads in industrial areas and on major highways, is not considered significant compared to existing traffic. This information will be part of the Community Health and Safety Plan.

## 8.6 Proposed Transportation Strategy

The use of trucks or rail to transport the processed sediment to landfills will be determined during the final design after the landfill and sediment processing vendor(s) have been selected.

## 8.7 Consultation and Road Network Issues

No special consultation or road network issues are anticipated at this time.

## 8.8 Monitoring Requirements

Monitoring requirements for the transportation of debris, treated sediment, and process-related wastes will be determined during the final design after the landfill and sediment-processing vendor(s) have been selected.

## Design and Preliminary Construction Schedule

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A project schedule including all major tasks and deliverables is included as **Appendix L**. The schedule provides approximate completion dates for the design and implementation of the RM 10.9 TCRA. Effective and open communications will be critical to achieving the aggressive milestones for the project. The status of ongoing efforts and issues that arise will be discussed at the monthly meetings.

# References

- AECOM. 2011. Low Resolution Coring Characterization Summary, Lower Passaic River Study Area RI/FS. Fort Collins, Colorado. July.
- AECOM. 2012a. Lower Passaic River Study Area River Mile 10.9 Characterization Quality Assurance Project Plan Addendum C: Data Gap Sample Collection to Support Sediment Removal Activities.
- AECOM . 2012b. Lower Passaic River Study Area River Mile 10.9 Characterization Quality Assurance Project Plan Addendum A.
- Barksdale, H.C., D.W. Greenman, S.M. Lang, G.S. Hilton, and D.E. Outlaw. 1958. Ground-Water Resources in the Tri-State Region Adjacent to the Lower Delaware River. New Jersey Department of Conservation and Economic Development Special Report 13, 190 p.
- Bridges, Todd S., Stephen Ells, Donald Hayes, David Mount, Steven C. Nadeau, Michael R. Palermo, Clay Patmont, and Paul Schroeder. 2008. "The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk." *ERDC/EL TR-08-4*. U.S. Army Corps of Engineers. February.
- C.F. BEAN Environmental LLC. 2001. Dredging for Environmental Remediation – New Bedford Harbor Pre-Design Field Test. Presented at the 2001 WEDA XXI Conference. Houston, Tex.
- Canizares, Rafael /Moffat and Nichol. 2012. Personal communication with Roger McCready/CH2M HILL. June 18.
- CH2M HILL. 2012a. River Mile 10.9 Removal Action Design Work Plan, Lower Passaic River Study Area. August.
- CH2M HILL. 2012b. River Mile 10.9 Removal Action Basis of Design Report, Lower Passaic River Study Area. August.
- CH2M HILL. 2012c. Lower Passaic River Study Area River Mile 10.9 Characterization Quality Assurance Project Plan Addendum B.
- CH2M HILL. 2012d. RM 10.9 Removal Action—Sediment Washing Bench-Scale Testing Report, Lower Passaic River Study Area—CERCLA Docket No.02-2012-2015.
- CH2M HILL et al., 2008. Lower Fox River Operable Unit 1 2008–2009 Pre-Final Design Report and Remedial Action Work Plan.
- CH2M HILL and AECOM. 2012. River Mile 10.9 Characterization Program Summary, Lower Passaic River Study Area. Prepared for Cooperating Parties Group, Newark, New Jersey. April 19.
- Dalton, R. 2003. "Physiographic Provinces of New Jersey." NJ Geological Survey Information Circular. New Jersey Geological Survey. Trenton, NJ. <http://www.nj.gov/dep/njgs/enviroed/infocirc/provinces.pdf>.
- dmi. (2012, August 1), Re: RM 10.9 Removal Action – Identification of Additional Area. CERCLA Docket No. 02 - 2012 - 2015. Clinton, New Jersey: Robert Law, CPG Project Coordinator.
- Foth et al., 2009. Lower Fox River Operable Unit 1, 2009 Remedial Action Summary Report.
- Ghosh, Upal. 2011. Update on PCB Partitioning Study.
- Hawthorne, S.B., Grabanski, C.B., and Miller, D.J. 2006. Measured Partitioning Coefficients for Parent and Alkyl Polycyclic Aromatic Hydrocarbons in 114 Historically Contaminated Sediments: Part 1. K<sub>oc</sub> Values. *Environ. Toxicology and Chemistry*, Vol. 25, 11, 2901-2911.
- Hawthorne, S.B., Grabanski, C.B., and Miller, D.J. 2007. Measured Partitioning Coefficients for Parent and Alkyl Polycyclic Aromatic Hydrocarbons in 114 Historically Contaminated Sediments: Part 2. Testing the K<sub>oc</sub>K<sub>BC</sub> Two Carbon-Type Model. *Environ. Toxicology and Chemistry*, Vol. 26, 12, 2505-2516.
- Louis Berger Group. 2010. Implementation Hudson River PCBs Site EPA Phase 1 Evaluation Report: Chapter III

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Evaluation of the Productivity Standard. March.

Lowery, Gregory, et al. 2009. Predicting and Validating the Field Performance of Novel Sorbent-Amended Sediment Caps. Submitted to NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology. [http://ciceet.unh.edu/news/releases/spring09\\_reports/pdf/lowry\\_FR.pdf](http://ciceet.unh.edu/news/releases/spring09_reports/pdf/lowry_FR.pdf).

Iannuzzi, T. J., and D. F. Ludwig. 2004. "Historical and Current Ecology of the Lower Passaic River." *Urban Habitat*. Vol. II, no. 1. pp. 3–30.

Iannuzzi, T. J., D. F. Ludwig, J. C. Kinnell, J. M. Wallin, W. H. Desvousges, and R. W. Dunford. 2002. *A Common Tragedy: History of an Urban River*. Amherst, Massachusetts: Amherst Scientific Publishers.

Lakes Environmental Software. 2012. WRPLOT View, version 7.0.0. <http://www.weblakes.com/products/wrplot/index.html>. Accessed on June 25, 2012.

McDonough, K.M., Azzolina, N.A., Hawthorne, S.B., Nakles, D.V., and Neuhauser, E.F. 2010. An Evaluation of the Ability of Chemical Measurements to Predict Polycyclic Aromatic Hydrocarbon-Contaminated Sediment Toxicity to *Hyalelia Azteca*. *Environ. Toxicology and Chemistry*, Vol. 29, 7, 1545-1550.

Meteorological Resource Center. 2002. New Jersey Surface Met Data, Newark Airport Station #14734. <http://www.webMET.com>. Accessed on June 25, 2012.

Michalski, A. 1990. Hydrogeology of Brunswick (Passaic) formation and implications for Groundwater Monitoring Practices. *Groundwater Monitoring Review*, Vol. 1, No. 4, pp. 134-43.

MPI. 2007. Lower Passaic River Restoration Project, Draft Source Control Early Action Focused Feasibility Study. White Plains, New York.

Moffat & Nichol. 2011. RM 10.9 Hydrodynamic Modeling

NJDEP. 1997. "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters." [http://www.nj.gov/dep/cmp/analysis\\_dredging.pdf](http://www.nj.gov/dep/cmp/analysis_dredging.pdf).

NOAA (National Oceanic and Atmospheric Administration). 2012. NOWData—NOAA Online Weather Data. <http://www.nws.noaa.gov/climate/xmacis.php?wfo=okx>. Accessed on June 27, 2012.

Palermo, M., Maynard, S., Miller, J., and Reible, D. 1998. "Guidance for In-Situ Subaqueous Capping of Contaminated Sediments." *EPA 905-B96-004*. Great Lakes National Program Office, Chicago, IL.

Stanford, S. D., 2001. Surficial Geology of the Orange Quadrangle, Essex, Passaic, Hudson, and Bergen Counties, New Jersey: N.J. Geological Survey Open File Map 41, scale 1:24000

USACE (U.S. Army Corps of Engineers). 2010. Lower Passaic River Commercial Navigation Analysis Rev 2. New York District. July.

USCHPPM (U.S. Army Center for Health Promotion and Preventive Medicine). 2006. Wildlife Toxicity Assessment for Phenanthrene, Document No: 39-EJ1138-01K.

USEPA (U.S. Environmental Protection Agency). 2005. "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites." *EPA-540-R-05-012 OSWER 9355.0-85*. December.

USEPA (U.S. Environmental Protection Agency). 2012a. Diamond Alkali, Lower Passaic River Study Area—River Mile 10.9 Administrative Settlement Agreement and Order on Consent for Removal Action. (Effective June 18).

USEPA (U.S. Environmental Protection Agency). 2012b. Regional Screening Level (RSL) Chemical - Specific Parameters, Supporting Table, April 2012. [http://www.epa.gov/reg3hwmd/risk/human/rb-concentration\\_table/Generic\\_Tables/pdf/params\\_sl\\_table\\_bwrun\\_MAY2012.pdf](http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/pdf/params_sl_table_bwrun_MAY2012.pdf).

ITRC (Interstate Technology and Regulatory Council). 2011. "Bioavailability to Benthic Invertebrates." Chapter 4 in *Incorporating Bioavailability Considerations into the Evaluation of Contaminated Sediment Sites*. [http://www.itrcweb.org/contseds-bioavailability/consed\\_4.htm](http://www.itrcweb.org/contseds-bioavailability/consed_4.htm).

# List of Drawings [Living List]

## 11.8 Dredging

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3		G-3	Civil and Structural Legend
4		A-1	Existing Site Plan
5	Civil	C-1	Existing Site Plan (Sheet 1 of 2)
6		C-2	Existing Site Plan (Sheet 2 of 2)
7		C-3	Sediment Sampling Locations
8		C-4	Post Dredging Elevations (Sheet 1 of 2)
9		C-5	Post Dredging Elevations (Sheet 2 of 2)
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## 11.1 Capping—In Progress

Sheet Number	Type	DWG	Title
1	General	G-1	Title Sheet/Drawing Index
2		G-2	Abbreviations
3		G-3	Civil and Structural Legend
4		A-1	Project Site Plan
5	Civil	C-1	Capping Plan
6		C-2	Post-Dredge Elevations
7		C-3	Cap Cross-Sections
8		C-4	Shoreline Support Area Layout
9		C-5	Water Quality Monitoring Locations

# List of Technical Specifications [Living List]

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## 12.1 Dredging

### 12.1.1 Division 01

- Summary of Work
- Project Meetings
- Project Schedule
- Submittals
- Submittal Procedures
- Construction Facilities and Temporary Controls
- Safety, Health and Emergency Response
- Environmental Protection
- Contractor Quality Control
- Water Quality Monitoring and Control
- Closeout Submittals

### 12.1.2 Division 02

- Shoreside Support Facilities
- Dredging

## 12.2 Stabilization

### 12.2.1 Division 01

- Summary of Work
- Measurement and Payment
- Contractor Qualifications
- Project Meetings
- Project Schedule
- Submittals
- Submittal Procedures
- Construction Facilities and Temporary Controls
- Safety, Health and Emergency Response
- Environmental Protection
- Contractor Quality Control
- Closeout Submittals

### 12.2.2 Division 02

- Stabilization Performance Requirements

## 12.3 Capping

### 12.3.1 Division 01

- Summary of Work
- Measurement and Payment
- Contractor Qualifications
- Project Meetings
- Project Schedule
- Submittals

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- Submittal Procedures
  - Construction Facilities and Temporary Controls
  - Safety, Health and Emergency Response
  - Environmental Protection
  - Contractor Quality Control
  - Water Quality Monitoring and Control
  - Field Engineering for Capping
  - Closeout Submittals

### **12.3.2 Division 02**

- Site Preparation
- Shoreside Support Facilities
- Silt Curtains
- Capping